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1943-1944

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THE Association was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of 800 men. Its membership is divided into six classes, viz.:

A Member shall be an officer or employee of a public or private water works, an engineer, chemist or other person qualified to aid or interested in the advancement of knowledge relative to water works.

An Honorary Member shall be a person of acknowledged eminence in some branch of water supply or of engineering.

A Junior shall be not less than eighteen years nor more than twenty-five years of age, a student or connected with water supply work.

An Associate shall be either a person, firm or corporation engaged in manufacturing or furnishing materials or supplies for the construction or maintenance of water works.

A Corporate Member shall be either a Water Board, Commission, Company or Municipal Corporation.

The initiation fees and annual dues are as follows:

	Initiation Fees		*Annual Dues*
Members	$ 3.00	Members	$ 6.00
Juniors	1.00	Juniors	3.00
Associates	10.00	Associates	20.00
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This Association has at least eight regular meetings each year, of which five are held in Boston, one in northern New England, one in southern New England, and one, the annual convention, held in September on such date as the Executive Committee may designate.

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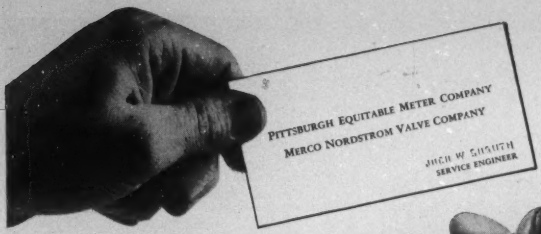

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Of course, a great number of our products are necessary and vital to the successful pursuit of the war. Other lines have been discontinued entirely for the duration. Selling, as such, is virtually a thing of the past, but engineering and technical assistance, particularly in maintenance and installation work, is very important. We have retained our entire staff, which has been carefully built over the years, to bring those in the field the maximum knowledge and experience in measurement and control.

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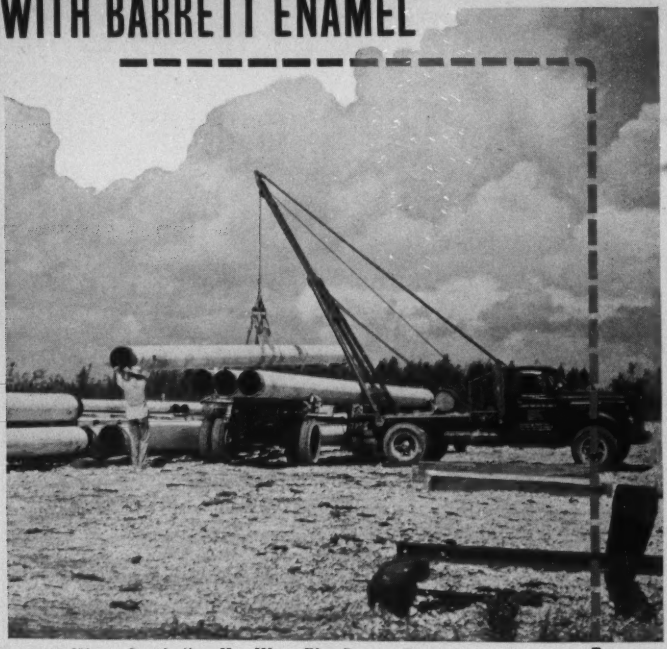

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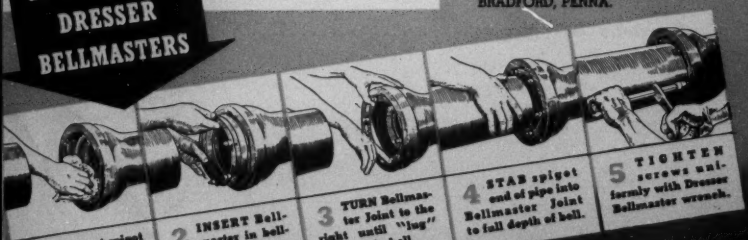

1 WIPE out spigot end of pipe and inside surface of bell in the usual way.

2 INSERT Bellmaster in bell-end of pipe with cap-screws facing out.

3 TURN Bellmaster Joint to the right until "lug" hits stop in bell.

4 STAB spigot end of pipe into Bellmaster Joint to full depth of bell.

5 TIGHTEN screws uniformly with Dresser Bellmaster wrench.

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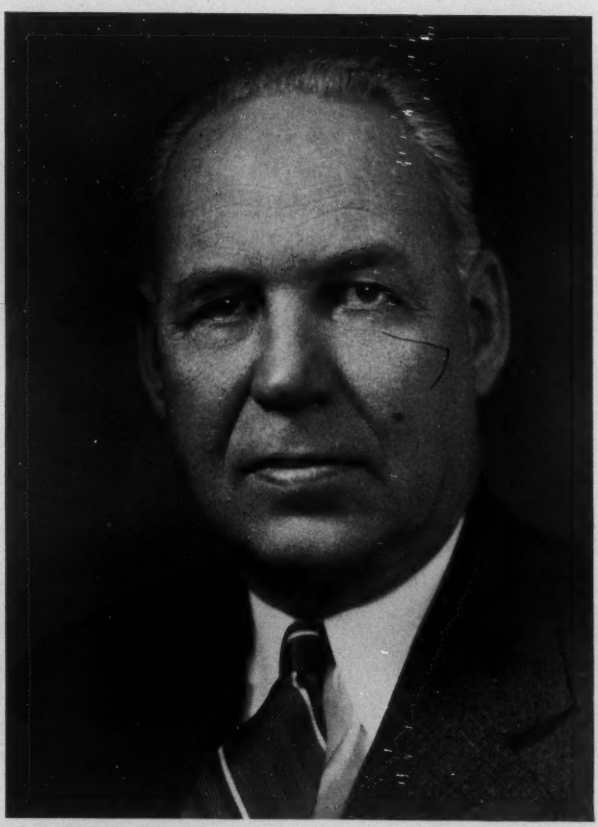

HORACE L. CLARK

President of the New England Water Works Association,
1943-44

New England Water Works Association
ORGANIZED 1882

VOL. LVIII March, 1944 No. 1

This Association, as a body, is not responsible for the statements or opinions of any of its members

ACTIVITIES OF THE COMMITTEE ON WATER AND SEWAGE WORKS DEVELOPMENT

BY E. L. FILBY*

[*Read September 29, 1943.*]

It is a privilege and a pleasure to be permitted to talk to you for a few moments on the work of the Committee on Water and Sewage Works Development and possibly to back up Mr. Chase's remarks to the effect that you men of the New England Water Works Association are the responsible parties for this Committee.

The program, as I understand it, was instituted here in New England and, as has been the custom in years past and so is the custom today, a good thing from New England spreads throughout the country. So it is that the Committee on Water and Sewage Works Development is now attempting a nationwide campaign, within the limits of the available funds and personnel, to see to it, if possible, that the water works and sewage men of the country take their just positions as leaders in the *postwar* development of our cities as well as in the present *wartime* programs of water and sewage works which are vitally necessary because of the needs of war industries.

In other words, we may briefly summarize the program to the effect that the water works man must now take a step beyond good management, a step beyond that of "delivering the goods"; he must take a step forward and be among the leaders in the postwar development.

The Committee formulated a certain program or platform, which has been transmitted, I believe, to many of you, but with your permission I would like to read a paragraph or two from it, because it does clarify the situation in far better phraseology than I could do.

Briefly, the broad premise—that is, the basis of this activity of the New England Water Works Association, the Federation of

*Field Director of the Committee, New York, N. Y.

Sewage Works Associations, the American Water Works Association, and the Water and Sewage Works Manufacturers Association—is that "every city in North America is entitled to have, and with good management is able to pay for, an adequate and safe satisfactory water supply, and as a good neighbor to other cities, likewise with good management, is able to dispose of its wastes in a manner that neither offends its own citizens nor its neighbors' citizens."

Now, that is a good platform to follow through. It is not a good platform to deviate from, and the Committee has instructed me to attempt to follow through on that premise. Believing that an adequate water supply and that intelligent waste collection and disposal are within the reach of every city, the Committee plans to stimulate the following activities in the cities of North America,—and here they are. It is a six-point program:

1. *An appraisal of the needs for water and sewage works, improvement or construction.*

That means that we should stop and think a little bit, take stock or inventory, as the saying goes, and see what our local problems are; possibly bring a few of the visionary dreams (which we all have had,—of what we would like to have some day when the millennium arrives), down to date, and put them on paper as something which may be consummated.

2. *The development of an orderly program for all these things in an order relating to their value to the city or the region.*

We all know that there are thousands of projects which have been listed which apply to water works and sewage development, which will still be on the lists a good many years from now, so we ought to check our local projects and evaluate them, give them priorities of performance, so that we may take up the first one first and the second in order of importance, and so on.

3. *The preparation of detailed plans and specifications for the needs of first importance as soon as arrangements can be made.*

Now, that topic is the reason for our slogan. If you happened

to pick up a copy of Water Works and Sewerage magazine recently you noticed on the cover page "Blueprint Now", in the form of a blue print, and the initials of our organizations. "Blueprint Now" means just what it says. Take these projects, which must be worthwhile, which must be of value to the community, which must increase the wealth and protect the health of the community—take these projects and reduce them to the blueprint stage. Do not just say: "We are going to spend $10,000 for water main extensions," or "we are going to add 500 meters," or "we are going to add a filtration plant." Take the next step. Authorize the preparation of plans and specifications for these improvements. Some of you can do it in your own organization with your own staff; some of you may have to have outside engineering assistance. But regardless of how it is done, let us do it NOW because the time is short. Projects, you know, cannot be conceived or developed overnight. We went through one of those stages during the days of the governmental contribution program; we had thirty or sixty days to get out a set of plans. The engineers had to do it, the cities demanded it, and some of the design was not as good as it could have been if more time had been available for detailed study. Now we have that time—let us utilize it.

4. *The construction of and development of methods of funding the necessary construction.*

I cannot tell you how to finance your project. I do not believe your neighbor can tell you that. You have to figure that problem out yourself. There are many ways of doing it. Some of you men have accumulated reserve funds—cash on hand—which you can utilize; others have been putting money aside into a capital fund for future construction. In still other cases, bond issues may be necessary. Perhaps revenue bonds can be utilized if there is a statute in your state authorizing the issuance of revenue bonds. In that connection I might just remark that one of the leading bond attorneys in the Middle West—I have not yet had time to interview anybody here in Boston—has said that revenue bonds might be issued to pay for the engineering, the preparation of these plans and specifications, especially on a water system which had been substantially financed. So that there are one, two, three, or half a dozen methods of financing

this work, the preparation of plans and specifications, which are necessary for the project. Of course consult your attorneys so you can visualize the method of actually financing the construction of the work.

In connection with finance let me make this blunt statement: The Committee believes that every city, every community, every town and every village should stand on its own two feet and do the work itself, without any financial assistance from the Federal Government.

Now, that is a challenge to every one of you, because we can all feel the influence of various and sundry governmental agencies who are interested in future work, who are interested in perpetuating themselves in office, for they are going to say: "We shall have available next year, or next month, all these funds, to assist you in this plan." But you know as well as I do that the tail often wags the dog in public works affairs rather than the dog wagging the tail, especially when the contribution of the federal government happens to be small. But enough for financing.

5. *A reappraisal of the authority under which the contemplated project can be carried on, as well as the legal basis for funding such operations.*

That is a sentence which summarizes a lot. Do you have to get any local legislation through your legislature to authorize this work, or are the present laws too cumbersome? If the latter, they should be modified and brought up to date, streamlined, if you will, in order that the work which is necessary, which is not only worthwhile but which will add to the health and well being of our citizens, can be carried on. You know your own local conditions far better than any national committee or any agency does, and you know the weak points in your legal structure.

6. *Definite scheduling of the construction program, and the immediate purchase of lands and rights of way if a part of the project.*

That is important. Engineers have to look ahead and communities have to look ahead, because we have got to keep ahead of the

demand. The "readiness to serve" which is utilized so ably in the electric industry is of course just as important in the water and sewage works industry. We have to be ready to serve the demands that come upon us. We may have to acquire lands for future construction, future improvements; we may have to secure rights of way for outfall sewers or sewage disposal plants, and so forth. Let us look ahead—let us get the sites, rights of way and material lined up now and definitely plan through the blueprint stage.

Why do we want to do it now? Well, there are two reasons, or maybe three. The first reason should be that we want to win the war. That may mean that we have to make improvements right now. Mr. Gorman, in his Office of War Utilities, knows that there are scores of cities in the United States which need improvements in water supply and distribution right now to assist in the war effort. That work will have to be done within the next few months or the war effort may be impeded, and we do not want to impede the war effort. We know we are going to win the war; we know the war is going to cease. It may gradually taper off or it may stop suddenly. No one knows. But are you ready when the wartime ends? Are you ready to institute a program of expansion of your water utilities and your sewerage systems? Are you ready when the city council or commission says: "We have got to start a public works program to take care of the returning soldiers and to supplement industry, which is now turning from wartime operation to peacetime performance"; are we ready to take care of these men? The water works men and the sewerage works men should be able to rise up and say: "We have available, ready for contract letting, projects totaling $20,000, $50,000, $1,000,000"—whatever is ready. If we have nothing ready, the other agencies in the field of public works—the roads, streets, park departments, recreational departments, and housing authorities—will be ready, some one of them will be ready, and the water works and sewage men should not be behind in the procession. Let us get up there and lead and be ready with our projects, because you know that when "Johnny comes marching home", Johnny may want a job. You know Johnny. He is the fellow up in the middle of the next block who was in the so-called non-essential industry a couple of years ago when the call came and he went to war. He left his

business. When he comes back, there may not be any business there at all, it may have been absorbed by a larger group and the local plant discontinued.

Then there will be John's younger brother Bill who had just got out of high school or college, who never had a job, did not want one and was not ready for one, but he went off to war, and while he was in training he married his sweetheart, and then a family came. You have seen the picture of that young man in the paper. When the lads come home what are you going to tell them? Are you going to say: "Well, we are sorry, but taxes are so high, and we are not making enough money to expand our staff, there is not much we can do about it; we are certainly sorry"? Are you going to tell him that? I don't believe so. I think we are going to take care of Johnny somehow, some way, and this program of public works, of water works and sewage works, is but one bridge between the end of the war and the time when industry will be changed over so that it can absorb the Johnnys and the Bills.

If we say: "Let the government take care of them"; then we will have sold the birthright of Americans. For at the close of this war, the United States of America will be at the forks of the road! If we go down to the right, we will go down the old American way, the way of private initiative, the way affording an opportunity of getting ahead and climbing up, getting to be somebody—the way most of us have come along the road of life; but if that way is closed and the sign says to go to the left, we will be going into a socialistic America. I don't think that you men want that to happen, and I know that you will take the necessary steps so that you will be ready to help returning America go down the road to the right.

POST-WAR PLANS FOR THE WATER SYSTEM OF NEW BEDFORD, MASS.

BY HOWARD C. MANDELL*

[*Read December 16, 1943.*]

The City Council of the City of New Bedford in September of this year adopted an Ordinance creating a commission on Post-War Planning, as follows:

"Section 1. There is hereby created a Commission on Post-War Planning, to be comprised of eleven members, to serve without pay, to consist of the mayor who shall serve as chairman, the commissioner of public works, the superintendent of the water board, the superintendent of buildings, the superintendent of street lights, the chairman of the wharf commission, the superintendent of parks, the superintendent of cemeteries, and three members of the city council.

"Section 2. The members of the city council on the commission shall be appointed by the mayor subject to confirmation by the city council. Members of the city council appointed to membership on said commission shall continue in that capacity until the expiration of their then existing terms as city councillors.

"Section 3. The Post-War Planning Commission shall meet at least once a month, and shall prepare plans for a public works program. The clerk of committees shall act as clerk of said commission and in that capacity shall attend and take minutes of all meetings. Records of the commission shall be kept in the office of the clerk of committees and open to public inspection. He shall perform such other pertinent duties as the commission may prescribe.

"Section 4. This ordinance shall take effect in accordance with the provisions of Chapter 43, General Laws. (Ter. Ed.)."

An organization meeting of this commission was held early this month with the Mayor of New Bedford as chairman. The problems of readjustment from war activities to peace time conditions and the rehabilitation of returning service men were considered at length. It was the sentiment of the meeting that the city of New Bedford could not hope to provide employment for all the returning service men and for the industrial employees who may be expected to be idle as a result of cessation of local war production. It was, therefore, voted to direct the Mayor to confer with leaders of local industry to ascertain, if pos-

*Superintendent, New Bedford Water Works, New Bedford, Mass.

sible, what plans they are making, if any, for conversion to manufacture of civilian products. It was also voted to request the various municipal department heads to prepare and submit to the Commission at its next meeting a list of worthwhile projects which may be undertaken after the war, with an estimate of the cost and the amount and type of labor to be employed.

As a member of this commission and one of the department heads affected by this request, I have endeavored to assemble the data on a number of projects that appear to me to constitute necessary improvements to the water system of the city. A summary of the projects with the estimated costs and total man hours of labor follows:

	Cost Dollars	*Labor Man Hours*
1. Extensions of Distribution System	500,000	400,000
2. High Pressure System, Rockdale Ave.	60,000	20,000
3. New Delivery Main from High Hill	600,000	300,000
4. New Screen House on Old Intake	25,000	10,000
5. New Repair Shop	150,000	125,000
6. Rehabilitate Old Acushnet System	25,000	10,000
7. Complete Black Brook Channel	100,000	100,000
8. Forestry Improvement—Credit $10,000	———	300,000

A brief description of the necessity for and the nature of each project will be given.

Project 1. Extensions of Distribution System. This project, because it can absorb a large amount of unskilled labor, and can be started almost overnight, appears to be best suited for construction by force account. There are 140 extensions of main pipe, varying in length from 150 ft to 8000 ft, with a total length of about eighteen miles. The sizes of main pipe range from 6 to 36 in. The total estimated cost is about $500,000. It includes such items as 30,000 ft of 6-in. pipe, 45,000 ft of 8-in. pipe, 12,000 ft of 10-in. pipe, 8,000 ft of 12-in. pipe, more than 150 main gate valves, 6 to 36 in. in size, 110 hydrants, and about 25 tons of special castings.

The extensions are necessary to promote public health, to provide for new consumers, to improve fire protection, and to improve circulation in the distribution system through the elimination of dead ends where possible.

It is estimated that with minimum use of mechanical equipment this project can absorb up to 400,000 man hours of local labor and can be scheduled to employ about 300 men for about nine months.

Pipe line construction during the months of January, February, and March is possible, as was demonstrated in the winter 1940-1941 at Fort Devens, but it should be a last resort during these months, because it is much more difficult and much more expensive.

If modern mechanical equipment is used, studies indicate that the total man hours would be reduced to about one-fifth of the number required with hand excavation and back fill and that the project would be finished in less time. It is not easy for executives and administrators who have strived for years to secure the most for their money through the use of labor-saving and time-saving techniques and equipment to return to inefficient and uneconomical construction methods; but it may well be that during the period of readjustment after the war, the provision of maximum employment must outweigh all other considerations.

An accumulation of a large number of comparatively small projects offers an opportunity for flexibility in methods and schedules of construction. Thus some of the larger extensions in this project might be constructed under contract, if proper supervision under force account appears impracticable.

The New Bedford Water Department does not have in stock at this time more the five per cent of the materials needed to complete this project. Prompt delivery of pipe, fittings, and valves will be essential. We are ready to issue proposals for all materials in this project at short notice, but it will have little value for providing employment if these materials are not obtainable promptly.

Project 2. Rockdale High Pressure System. There is in the west central section of New Bedford an area of about one square mile, within the limits of which the water pressure is not sufficient to furnish adequate fire protection and satisfactory domestic water service. It is proposed to create a higher pressure in this area by constructing an elevated storage tank on the highest ground, filling the tank by means of an electric centrifugal pump with automatic controls, separating the high-pressure distribution system from the normal system by means of check valves and pressure-regulating valves located in our existing

mains at elevations where present pressures are satisfactory.

The design of this project will require (1) studies of present and probable future population and water consumption in the area to determine the capacity of the storage tank and pump to be installed and (2) the determination of the minimum pressure which will provide good fire protection and domestic service. Such studies have not as yet been made, and the estimate is, therefore, approximate only. This project will require several months for complete preparation of plans and specifications.

Project 3. New Delivery Main from High Hill Reservoir. We are able to supply water from the pumping station to the distribution system through either, or both, of two methods. The original method, which was used exclusively until September of this year, was to pump all water to High Hill Reservoir and distribute it from this point by gravity. High Hill Reservoir is about eight miles from the Quittacas Pumping Station and is connected to it through two parallel 48-in. force mains. The overflow level of the reservoir is 216 ft above mean low water in New Bedford Harbor and provides pressures ranging from 90 psi at harbor level to a minimum of 16 psi at the highest hydrant in the system.

There is also a direct supply line from a point on the force mains about two miles from the pumping station to the distribution system in the city. This direct connection consists of about two miles of 48-in. main and three miles of 36-in. main in series. The distribution system is supplied from High Hill Reservoir by means of two parallel 36-in. distributing mains which branch apart about three miles from the reservoir and feed into the ends of a loop of 30-in. main which forms the basis of the grid system in the developed part of the city.

The original method of pumping water to High Hill Reservoir was satisfactory as long as the maximum rate of consumption remained at or near 10 mgd. At larger rates, the friction loss in the two parallel 36-in. distributing mains causes an excessive lowering of pressure throughout the entire distribution system, actually entirely depriving of water certain takers of water in the area of high ground referred to in Project 2. As a result of increased industrial activity, our average daily consumption has increased from about 10 mgd in 1940 to about 12½ mgd this year.

In September of this year, it was decided to open the direct supply line to the city to improve pressure conditions. When this was done, pressures rose an average of 6 psi throughout the system. The reversal of flow in certain sections stirred up deposits of rust and sediment which careful and thorough advance flushing had not removed, and we had an avalanche of complaints for two or three days. This condition then corrected itself, and we have continued the dual method of supply.

Project 3. New Delivery Main from High Hill. This project contemplates the construction, under contract, of a new 48-in. distributing main about six miles long between High Hill Reservoir and the city over a different route than is followed by the present 36-in. mains. There will then be sufficient pipe capacity between the reservoir and the city to insure good pressures at times of large consumption, whether it is caused by fire or normal use. The preparation of complete plans and specifications for this project will require at least two months.

Project 4. New Screen House on Old Intake. The Quittacas Pumping Station takes water from Little Quittacas Pond through two intakes, each of 5-ft internal diameter. The original intake was installed in 1898. Removable screens were provided in the original installation. It was found, however, that under certain conditions of temperature and wind, these screens became completely blocked with frazil ice, which made it necessary to suspend pumping operations. An endless rotary screen was designed and constructed in the intake house by Mr. Negus, the former chief engineer at this station. It has served its purpose very well for thirty-five years, but it is in need of major repairs.

A second intake was constructed in 1923 under plans and specifications prepared by Frank A. Barbour. In this intake, the screen house was provided at a point on the shore near the pumping station. Experience has shown that a location on the shore and near the station is far superior to an installation in the intake chamber. It is therefore proposed to construct a new screen house and screen on the shore in the original intake. No complete plans and specifications have been prepared for this work as yet.

Project 5. New Repair Shop. The building which houses the

tools and equipment of the maintenance division for the distribution system is in exceedingly poor state of repair. Tentative plans and sketches have been prepared for the construction of a new building specifically adapted to our needs at the present location. It is hoped that funds will be provided in the budget for 1944 to secure the services of an architect to prepare complete plans and specifications for such a building, so that the work may be started promptly when labor and materials become available.

Project 6. Rehabilitation of Old Acushnet System. The health of 120,000 people and the continued operation of the numerous industries in New Bedford depend absolutely upon the uninterrupted operation of our Quittacas Pumping Station. We have no secondary or auxiliary source of supply in operating condition. It is not feasible to make connections with adjoining cities because of the distances and costs involved. The old Acushnet System, which constituted the supply of the City of New Bedford prior to the introduction of Quittacas water in 1900, will provide at a receiving reservoir, located in the northern part of the city, a maximum of 8 mgd at an elevation 30 ft above mean low water in the city harbor. The installation of pumping and chlorinating equipment and some minor cleaning and repairs are the only things needed to make this system available to supply water under pressure to the existing distribution system.

Application has been made to the War Production Board for authority to secure equipment for this purpose, but because the application is for stand-by service only, it has not been approved by them. Plans and specifications for this project are complete, and it could be started as soon as materials and equipment become available.

Project 7. Complete Black Brook Channel. This project involves the improvement of drainage in a swamp which is a tributary to Great Quittacas Pond. About two miles of channel with an approximate cross section of 250 sq. ft, remain to be excavated through the swamp. Plans are complete, but it will be necessary to secure easements across private property before construction can be started. The improvement in the color and odor of water drawn from other swamps in which drainage has been completed shows that such treatment is decidedly beneficial.

Project 8. Forestry Improvement. The city of New Bedford

owns about 3000 acres of land on the watershed surrounding the ponds which furnish our water. About half of this area has been planted to evergreens, the earliest plantations being now more than thirty years old. The balance of the area is heavily forested with a mixture of hard woods and evergreens.

A survey was made recently by an agent of the Massachusetts Department of Conservation, and recommendations were submitted by that department for cutting and improvement of the entire area. In line with these recommendations, it is possible to employ several hundred men during the winter in cutting and stacking hard woods and in cutting and trimming pine, spruce, and hemlock suitable for lumber mills.

You will note from this information that we have not yet found it possible to blueprint all of these tentative projects. We hope to make further progress in this direction during the coming year.

PUBLIC WORKS AFTER THE WAR

BY ELISABETH M. HERLIHY*

[*Read September 29, 1943.*]

Two years ago today—September 29, 1941—we were a nation at peace with all other nations. Meats, butter, sugar, coffee, and all articles of food were to be had in abundance, while limitations upon the use of gasoline and of fuel oil were undreamed of. Our vast army of the unemployed had marched valiantly forward from the depths of the depression of ten years earlier, through CWA, ERA, CCC, NYA, PWA, PWR, and WPA in an effort to achieve that Freedom from Want which was later to find formal expression in the Atlantic Charter as one of the four goals essential to our American way of life.

Even then, Europe was crimson with the blood of England, Russia, Italy, Norway, Belgium, France, Greece, and Germany. Quietly but effectively the Nazis were strengthening their approach to Tunisia, Sardinia, Sicily—names then seldom heard but soon to become almost household words. Corsica was associated in our minds with Napoleon but not with Hitler.

Across the Pacific, we knew in a general way that China was being invaded, attacked, and persecuted by the Japanese, but our reaction was little more than perfunctory. We sat remote and smug in our ivory tower, feeling if the truth must be told, a bit superior to all these warring countries. True we had our sympathies as evidenced by our lend-lease pact, and we condemned roundly the isolationists and the totalitarians, and we held out a helping hand here and there, but, beyond that, when all was said and done, it definitely *was not* our war.

The newspapers on the morning of September 29, 1941, recorded the facts that the Nazis had seized the Czech Premier on a so-called charge of treason and that the Russians had sunk five ships of the Reich, but these facts were quite lost sight of in the headlined announcement that Ted Williams got six hits in eight trips to the bat

*Chairman, Massachusetts State Planning Board; Member, Emergency Public Works Commission.

to finish the year with an average of .406—the first Boston major leaguer to attain a .400 or better average since the immortal Hughey Duffy rated .438 in 1894. All New England sympathized with the parents of five-year old Pamela Hollingsworth who was lost in the New Hampshire forests; and finally that Joe Louis justified the betting on him—12 to 4—by knocking out Lou Nova in the sixth round. Verily, up to that point, it *was not our war!*

Ten short weeks of security and peaceful pursuits and the tragedy of Pearl Harbor burst upon us with tremendous force and galvanized us into immediate action. In less than two years, an armed force approaching ten million has been mobilized for military duty; one and one-half million men and women are engaged in building ships; another one and one-half million are directly involved with producing ammunition and guns; other millions are engaged in war industries of one sort or another; until today fully one-half of our total national energy is devoted to combat purposes.

Some day, and no one can foretell how soon, but perhaps with the same shocking suddenness as came the attack upon Pearl Harbor, will come the dramatic announcement that World War II is at an end—and then what? Will that announcement find us any better prepared for peace than did the attack upon Pearl Harbor find us prepared for war? From the standpoint of economic planning, the problem of mobilization for war was relatively simple. Patriotic fervor and a spirit of exaltation rather than argument stirred us to the building up of our military forces on the land, on the sea, and in the air. We knew within reasonable limitations the magnitude of the industries required to provide the equipment necessary for the Army, the Navy, the Marines, and the Air Force. The objectives were clear, compelling and rapidly achieved. Only within the last few days, the Navy Department, in a special interim report, lays claim to the mightiest surface fleet in world history, backed by the most powerful naval air force of any nation. With unbelievable speed, we have reached the heights.

The "way back," however, offers no such stimulating and inspiring objectives. With the dawn of peace, some 25 to 30 million will face major readjustments. Jobs will have to be found for perhaps 8 million, demobilized from the armed forces. Many of the jobs

formerly held will have disappeared as the result of economic conditions or of technological change; five or six million elderly people, young people, and women will be retiring, picking up school where it was dropped, and returning to home duties. Younger brothers will have grown up and will demand that equality of opportunity, which is the bulwark of our democracy. Other millions now employed in war industries will be compelled to seek new means of livelihood.

To all of these, to the war workers returning to civil pursuits no less than to the soldiers returning from the battle front, to the elderly people, the young people, the WACS and the WAVES, to all of these and to all the myriad of others engaged in the war effort, America owes a debt which it can never fully pay. No effort must be spared, however, in an attempt to meet the immediate responsibility of fitting these millions of people smoothly back into the pattern of our peacetime industrial, business, educational, and social life.

As a Commonwealth, we here in Massachusetts are meeting this challenge squarely without lessening in any particular our efforts in behalf of the main objective—that of winning the war. Winning the peace is recognized as merely the second step, and the permanent success of the first step can be assured only if we have learned to lay the foundations wisely and well for what might be termed the second front in our community life.

The Emergency Public Works Commission was created, by Legislative Act, in 1933. The Federal Government having offered to assist by grants and loans in the financing of state projects, the General Court by Chapters 365 and 368 of the Acts of that year established the Commission and authorized it to select the projects and to make the necessary arrangements with the Federal authorities.

In the ten years of its existence, the Commission has reviewed projects totalling approximately $50,000,000, of which $20,000,000 was received from the Federal Government in the form of PWA grants. By far the largest single undertaking by the Commission was that authorized under Chapter 501 of the Acts of 1938 for further development of the new source of water supply for the Metropolitan District. The total allotment for the project was $15,982,000, of which $7,191,900 was a Federal grant, leaving $8,790,100 to be borne by the District.

Other projects, to the number of 150 or more, have included hospitals, sanatoriums, college buildings, armories, sewer, water and park developments, bridges and waterways, power houses, fire and police buildings, and roads.

Dr. Henry LeFavour, a member of the Commission by appointment of the Governor, was elected as Chairman in 1933 and has served in that capacity throughout. Another member by appointment of the Governor is Hugh Nawn of Boston, who has served in times past as a consultant to the Commission. At the present time he replaces as a military substitute Charles P. Howard who has served continuously as a member of the Commission, first by virtue of his position as Chairman of the Commission on Administration and Finance and later by appointment of the Governor. Hall Nichols of Wellesley has served throughout as Secretary and Chief Engineer. The entire administration of the office, all correspondence and records have been personally supervised by him.

I mention these facts merely to emphasize the high quality of membership which has obtained and the continuity of service which has been of inestimable advantage. This membership has been further strengthened by the addition of Paul W. Foster, present Chairman of the Commission on Administration and Finance, ex-officio; Robert L. Whipple of Worcester by appointment of the Speaker of the House in 1934, and Edward B. Richardson of Brookline by the President of the Senate in 1937.

To this goodly company was added by Legislative Act in 1943 the Chairman of the State Planning Board, together with definite instructions, first to prepare a program of post-war public works which may be undertaken by the Commonwealth; second, to "prepare and maintain current progress information on the design of post-war projects by municipalities of the Commonwealth"; and, third, to maintain liaison with Federal officials and agencies concerned with post-war planning.

In carrying out the first of these mandates, *i.e.* "to prepare a program of post-war public works which may be undertaken by the Commonwealth," the Commission has first reviewed a group of projects already approved by the Legislature, and for which funds have been appropriated and, in a number of cases, plans already

prepared. The actual carrying out of these projects has been delayed on account of shortage of material or manpower. In all, they total about $1,000,000 and represent mostly items of repair necessary by reason or safety or sanitary conditions. To that extent, the program is now all ready for action.

In addition, the Commission is now receiving from department heads a list of projects needed or desired, arranged in order of priority. From these projects a program will be developed and submitted to the Governor. This program must—and will—be based not only upon the desirability of the projects themselves from the point of view of the Commonwealth but also upon their labor-producing possibilities.

The program is only the first step, however. As stated in one of the engineering papers recently: "The time for post-war planning has passed; the time for designing is here." The Commission has been assured by His Excellency that it may draw upon the war emergency funds in his possession for plan preparation to such extent as the Commission believes, and can demonstrate to the Governor, is essential to the best interests of the Commonwealth. I hope I am not divulging any State secret, and in fact I think His Excellency has made the statement publicly, that $700,000 was within the realms of possibility for plan preparation. This means approximately $17,000,000 in construction on the basis of 4 per cent of the construction cost for plan preparation. Whether or not $700,000 is the actual amount available for plan preparation is of little moment. The important fact is that it is a matter in which His Excellency is deeply and personally interested, and he has placed no ceiling upon our own efforts in developing the program.

In an attempt to "prepare and maintain current progress information on the design of post-war projects by municipalities," the Commission has communicated with each one of the 351 cities and towns in the Commonwealth, either through the mayor or board of selectmen, asking if they have appointed a Post-War Committee and urging immediate action. In many of the communities, the local planning boards (of which there are 160 in the State) have been either designated as the Post-War Committee or are represented on it, so that both through the Emergency Public Works Commission

and the State Planning Board every effort will be made to coöperate with them and to stimulate action. So far, replies have been received from about 150 communities where post-war committees have been appointed. In a number of places, lists of projects have been prepared and, in a very few instances, plans are in readiness.

In the State of New York, the Post-War Public Works Planning Commission is authorized to give financial assistance to local communities to the extent of 50 per cent of the cost of plan preparation. This situation does not prevail in Massachusetts. It is my understanding, however, that most of our local communities are in a much better shape financially and that their borrowing capacity is considerably greater than was the case two years ago.

It is a fact that under the terms of a permissive measure enacted in 1943, communities are now permitted to invest up to 5 per cent of their assessed valuation in war bonds. So far, these purchases have reached a total of between 4½ and 5 million dollars. While the object is to make this money available for war purposes and to maintain funds to meet post-war conditions, there are nevertheless certain definite restrictions, including a provision that the bonds cannot be sold prior to the termination of the war.

The question arises constantly as to what is to be expected from the Federal Government; but up to the present time this is an unknown quantity and must remain so until such time as Congressional action is taken. I am told that since January 1 no less than 25 bills have been introduced in Congress, all looking to the post-war readjustment period. Some of the House bills, of course, are merely duplicates of Senate bills, and some of the bills in the upper chamber are Senate versions of House bills. One Senate bill, introduced by Senator George, has been passed creating a Senate Committee to study the whole post-war problem and to make recommendations for legislation. Some of the bills have reference to international post-war arrangements rather than the domestic economy. Most of the remaining bills would create commissions or committees to study the situation. Among the exceptions are: a bill that would make 100 million dollars immediately available to be used for actual advance engineering surveys and plan preparation—the Beiter-Lynch-Mead bill; a bill providing a method for the accumulation of financial re-

serves for post-war works—the Rivers bill; a Senate bill, introduced by Senator Thomas, creating an Urban Redevelopment Agency and authorizing an appropriation of 150 million dollars for land acquisition for urban development; and, finally, a bill introduced by Senator Wagner carrying an appropriation of one billion dollars for Federal assistance to states and localities in assembling large tracts of land preparatory to sale or lease for development.

For the present, therefore, until Federal policies with respect to the post-war period shall have become crystallized, the only safe course is for the State and the local communities to go as fast and as far as they can within their own financial limitations on a program that can be speeded up later by Federal appropriations if they should become available. Such a program should include not merely a list of projects but actual plans and specifications. Wishful thinking should give way to definite action forthwith. To quote Major General Philip B. Fleming, Adminstrator, Federal Works Agency: "Good intentions alone build no public improvements and pave but one well known road."

The State highway program is in a slightly different category. The Public Roads Administration of the Federal Works Agency has an appropriation of ten million dollars, which is being used to advance 500 million dollars worth of highway work to the contract stage in 22 of our 48 states. In this work, the states are required to match the Federal contributions. In addition, there is a bill now pending in Congress to make available three billion dollars for highway construction over a three-year period. The bill is advocated by the American Association of State Highway Officials, which estimates that a billion dollars a year spent for highways will provide jobs for 750,000 men annually.

The work I have just outlined has been proposed on the assumption that pending what has been referred to as the "switch back" period, or retooling process, the Government must assume a portion of the employment problem. The extent or nature of this problem no one can foretell with any degree of accuracy. We do know, however, that following the Armistice in 1918, there was a brief period of prosperity, followed by a minor depression which reached its climax in 1921, then recovered to a certain extent only to start upon its major downward spiral in 1923.

From time to time we are given a fascinating preview of the activities to be expected after the close of the present war, in the fields of television, helicopters, and plastics, to mention only a few of the more spectacular. This is a situation of great promise, for there is no gainsaying the fact that the future of our country depends ultimately upon private industry, adapted to the various regions of the country, and sustaining the future of our system of living.

A committee which is doing very effective work in this State, particularly in connection with the stimulation of jobs in private industry, is the Committee on Post-War Readjustment, of which Melvin T. Copeland, Professor of Marketing at the Graduate School of Business Administration of Harvard University, is Chairman and James W. Culliton, Professor of Management, on leave of absence from the School of Business Administration of Boston College, is Director. The Committee was appointed by Governor Saltonstall in November 1941, one month before Pearl Harbor, as an advisory group to explore ways and means of avoiding a *post-defense* depression.

Of the 32 members originally appointed, three represented agriculture, seven business, banking, merchandising, and publishing, five manufacturing, five labor, six education, and five ex-officio members representing the planning and administrative departments of government.

In its work, the Committee has consistently tried to avoid usurpation of the power and authority of already existing agencies of the state government. Because it is essentially a temporary Committee and also because as a matter of policy it has been concentrating its attention largely on the early post-war period (*i.e.* especially the first three to six months and not more than two years after the end of the war), the Committee tries to pass on to existing agencies all problems of a long-run nature and those which existing agencies are authorized and set up to attack.

The legislature of the Commonwealth of Massachusetts in June 1943 approved the existence of the Committee and specifically authorized its continuance by granting it funds with which to work during the two-year period beginning July 1, 1943. Incidentally, this Committee is working in close coöperation with the Committee for Economic Development.

Finally, there are three Legislative Recess Commissions whose activities doubtless will exert a definite influence upon the post-war period.

The first of these is a special unpaid commission established originally by the General Court in 1941. Members of the Legislature, representatives of the Governor and of the Mayor, and state officials make up the membership. One of the specific projects referred to the Commission, the life of which was extended by the 1943 Legislature as a Post-War Highway Commission charged with the duty of transmitting to the State Department of Public Works a list of post-war projects designed to relieve or eliminate traffic congestion in the Commonwealth, is the so-called Central Traffic Artery and other related thoroughfare improvements in and near the City of Boston as proposed in Senate Bill 592 of 1941. To meet the cost of these projects, a bond issue of $19,400,000 was proposed. The whole broad program is now being studied by a committee of engineers within the group. If approved in whole or in substantial part, and if money is made immediately available for plan preparation, and eventually for construction, it would afford a sizable post-war public works project.

Another special commission provides for a comprehensive study relative to rapid transit in the Boston Metropolitan Area. Members of the Legislature and the Department of Public Utilities constitute the Commission with the coöperation of the Department of Public Works, the State Planning Board, and the Boston Transit Commission.

The approval of plans for the development of the Boston Airport, at this time, including three 7,000-ft. runways and one 5,000-ft. runway, together with an approved initial expenditure of $4,750,000, gives additional impetus to the work of this Commission at this particular time. The success of the Airport is of necessity dependent upon adequate approaches, and this means intensive study of existing conditions, their possibilities for expansion, and the coördination of the entire development into an efficient and smoothly functioning rapid transit system for the area.

Finally, there is the Post-War Rehabilitation Commission created by the 1943 Legislature with broad powers relative to studies of agriculture, industry, housing, urban redevelopment, and man-

power, with a view to providing for a minimum of unemployment and a maximum of opportunity for persons now in the armed forces of the United States or now engaged in a civilian capacity in war work who may be thrown out of employment at the close of the war. Five members of the Senate, thirteen members of the House, and seven persons appointed by the Governor comprise the Commission, which is given an appropriation of $25,000 for its work. The Commission is not yet fully organized, so that no plan of action has been discussed.

In all of these statements, I have made very little mention of the State Planning Board; yet it is the one permanent organization in the group. We are represented through membership on most of the Commissions and are working in close coöperation with all of them. It is our hope that the programs which may be decided upon now as a measure of preparedness against the demands of the post-war period, may be made to fit into our own long-range plans for the future development of the Commonwealth. Our own studies, which I have not attempted to discuss here today, are going steadily forward and will, I hope, act as a framework into which proposals from whatever source may be fitted.

When all is said and done, what do all of these post-war activities add up to? Is there any logic or reason in them? To me they are very significant and reassuring. During World War I, it was my privilege to function as Executive Secretary of the Committee on Public Safety of the City of Boston. We had Committees on Food Production and Conservation, on Trucks and Motor Cars, on the Promotion of Universal Military Training, on Hygiene, Medicine and Sanitation, on the Coördination of Aid Societies, on Recruiting, and on the Protection of Property, but I do not recall any suggestion from any source at any time having to do with the period *after* the war. To that extent at least, we are infinitely better prepared than was the case 25 years ago. The task is not finished by any means, neither on the battlefront nor on the home front, but I do believe that when, in the Providence of God, our boys come home, they will find more than parades and brass bands awaiting them; they will find jobs commensurate with their abilities and affording them an opportunity for economic security; an environment that makes for joyous living; and a secure place in the hearts of a grateful people.

POST-WAR PLANNING IN INDUSTRIAL NEW ENGLAND

BY DUDLEY HARMON*

[*Read September 29, 1943.*]

Speaking for the New England Council, I want to congratulate this Association on having effected organization on a regional basis a good many years ago. I say that because the chief purpose for which the New England Council was organized was to bring New England interests together so that they could work out in an association with one another and on a regional basis the problems confronting them and the six states.

I hope you will clearly understand that I appear before you not as an authority on post-war planning, but rather as a spokesman for the very great interest which the New England Council and the Committee for Economic Development have in such planning. Before beginning a discussion on that subject with this group I should certainly say a word of congratulation to your own association for its leadership in giving attention to the problems of the post-war period. So far as we in the Council know, the New England Water Works Association was the first regional business organization in the New England states to bring forward a program of specific, and, it seems to me, very sensible suggestions, for activities on the part of your group which would tend to maintain employment in the post-war period. I was very much interested, therefore, in hearing the remarks this afternoon of Mr. Chase and Mr. Filby, indicating your substantial further progress in preparing to deal with these post-war problems and post-war opportunities and responsibilities.

Reference has been made to the matter of maintaining employment when the war comes to an end. It seems to me without any question that maintaining employment is the key phrase not only of the New England Council and the Committee for Economic Development, but of all business in reference to post-war conditions.

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It is not merely altruism and it is not merely patriotic duty that makes the business leadership that is interesting itself in these matters so deeply concerned now with post-war problems. It is, in very large degree, the exercise, the activity, of a very healthy and well-developed instinct for self-preservation. I think that most men agree today that it was the conditions resulting from mass unemployment in great volume over long periods of time which gave the dictators in Germany and Italy their opening wedges and their opportunity to seize power, and when in control of government, to make government the people's master rather than their servant.

We saw in the early '30s how our own government was compelled to adopt the most unprecedented and extraordinary measures as a means of dealing with the very high volume of unemployment that developed in this country at that time. I think it is generally conceded by our business men today that no national administration can ever stand by and do nothing about another prolonged period of mass unemployment here. If we have mass unemployment in the United States after the war, I think we can regard it as an established fact that the national government will move into the situation without much delay and will take steps to provide employment in one form or another that will make our experience of the early '30s seem rather mild and tame. In so acting, the national government will of necessity be brought to the point of establishing controls that will be lasting and drastic. Therefore, the chief concern today of enlightened business leadership in this country is to prepare now so that it will be unnecessary for the government to become the chief provider of employment. Thus we shall contribute to the preservation of our free enterprise system and allow business to proceed and develop along the lines of sound economics and its own experience and judgment.

There may be those who doubt that there is a danger of these unpleasant things occurring in this country. If there are such doubters, I would ask them to note the statement made only last Sunday in the city of Worcester, in this state, by Philip Murray, President of the CIO. Speaking at the steel workers convention he said: "If at the end of this global war there is a powerful labor movement, the people should not be troubled too much by post-war planning." Then referring to employers he continued: "If unable, after an earnest trial, to meet these

responsibilities" of the post-war period—meaning by that, to provide jobs—then they "should come to the government and labor and say, 'Let us work it out together.'" Again quoting Mr. Murray: "Most of us believe that the free enterprise system should be preserved; but that depends substantially on the people who operate the mills, factories, mines, and so on, and who own them." Now, Mr. Murray's pronouncements are not yet accepted as the law of the land, but I would venture that he who would undertake to dispute Mr. Murray's statements would find himself on the losing end of the argument.

What of the situation in New England, particularly industrial New England, with respect to post-war planning? There is one thing we can be sure of, and that is that the New England state governments will make very substantial expenditures for public works. I think Miss Herlihy has made it very clear that a great deal of planning for public works expenditures has already been done in the state of Massachusetts, and much the same situation is true in the other five New England states. Most of the states have put these matters in the hands of existing planning and development commissions. Connecticut has just set up a special post-war planning commission. I think Massachusetts is somewhat ahead of the other New England states in this field, but the other states are catching up fast, and we can be absolutely sure that there will be very substantial expenditures and activity along those lines. The situation as to the cities and towns in New England by states is by no means as clear. It is very spotty. Some cities and towns have done a good deal; others have done absolutely nothing.

Now I come to the program of the Committee for Economic Development. As you know, I happen to be the regional vice-chairman of that committee. I hold that position for one particular reason: to make it clear to those who have any interest in the activities and duties of the New England Council that the Council is an organization that thoroughly and wholly believes in the activities of the Committee for Economic Development and is using its facilities and resources to further the program of the Committee in the New England region.

As most of you know, the Committee for Economic Development includes some of the best business leadership that our country has developed. It is headed by Paul Hoffman, President of the Studebaker Corporation. He is associated with the type of American business men

with whom we are all happy to have our organizations allied. They are absolutely free from government influence, domination or subsidy. They are privately financed. Their form of organization is a board of trustees. CED is headed by a group of men completely free and independent to exercise their own best judgment in the matters with which they are concerned.

The Committee for Economic Development has two divisions: the research division and the field development division. I want to speak first about the research division. The Committee is perfectly well aware that both during the period preceding the war and in the war period itself a great many restrictions and handicaps have been imposed upon business, which, if continued, will make it extremely difficult for any business to do its full part in establishing and maintaining an expanding economy in the post-war period. The Research Division is concerned with finding the facts as to these conditions and making specific recommendations for the removal of obstacles to the functioning of a free enterprise system of business. They are endeavoring to submit recommendations, the adoption of which will improve the economic climate in which all business has to function.

I might mention that Mr. Ralph E. Flanders, President of the Jones & Lamson Machine Company of Springfield, Vermont, and former President of the Council, is the representative of the Research Division. Mr. Sumner Schlichter, widely known throughout the country as a distinguished labor economist, is chief of the Research Advisory Staff, and Mr. Donald David, Dean of the Harvard Business School, is also a member of the research division of the CED.

The Committee for Economic Development will not undertake to lobby for the findings and recommendations of its Research Division; on the contrary, it will place its findings and recommendations before business as a whole and leave it to the businessmen, if they approve of the proposals made, to do their part in bringing them to the attention of the executive and the law-making portions of our government.

Now, a word about the Field Development Division of the Committee for Economic Development, which is the group already active here in New England, and in whose work we of the Council are not

only much concerned but take as much part as our facilities and resources permit.

The Field Development Division is a regional organization based on federal records districts. As you know, New England is Federal Records District No. 1. The chairman for the region is Mr. Henry P. Kendall, President of the Kendall Mills and the Kendall Company, a man widely recognized as an exponent of progressive industry.

In each New England state there is a state chairman, who is always a business man of standing in his state and community. The organization is next carried down to the community. The Committee desires to have local committees in every industrial city of 10,000 or more. Up to date, fifty-nine* local city committees have been organized in New England—three in Maine, twenty-one in New Hampshire, seven in Vermont, sixteen in Massachusetts, four in Rhode Island, and eight in Connecticut. All of those committees, when organized, are supposed to follow a well-established procedure in their groups.

But bear in mind that the Committee for Economic Development itself is not trying to take over the post-war planning either for American business, American industry, or any group. Rather, the Committee has dedicated itself to the job of stimulating all business men, large and small, to do their own post-war planning, and to start doing it now. The Committee has no readymade plans to impose on anybody, or even to sell to anybody. They do have a procedure, however, that they are exceedingly desirous of selling to every unit or management in American business, except, of course, the very small units.

The local committee, as soon as it is organized, is asked to send to each manufacturer within its area a check sheet which calls for certain information. It requests the manufacturer to state how many people he employed in 1940, how many he employs at the present time, in the war period. Then he is asked to make a rough analysis of his present work force with a view to finding out how many of his present employees will not be interested in continuing in his employ after the war is over. In other words, to arrive at some estimate as to the number who will return to former homes elsewhere, the number who will return to some other job in the same community, and the number who will not be seeking any employment—that is, young people of

*Sixty-five as of October 21, 1943.

school age, housewives, retired persons, or persons of independent income who may be working now as a contribution to the war effort. Following this, the number of former employees in the armed forces who, when they come home, will be looking to the former employer for a job is requested as well as an estimate of the number of employees the employer will need to produce and distribute his estimated post-war volume. And finally, he is asked for the name of the executive in charge of post-war planning in his establishment.

Now, that is not a very elaborate check sheet or questionnaire, but I would like to call to your attention certain points and emphasize that they do have real significance. In the first place, the local Committee for Economic Development asks every manufacturer addressed to name the executive to whom has been delegated the responsibility for developing post-war plans in that particular company. You know very well that there are many companies which, if asked that question today, would answer, "Nobody." In other words, the Committee is not interested in getting names; it is interested in putting up to the individual manufacturer his responsibility, his duty, the necessity for him to designate some executive—whether it is himself as the top man or one of his associates—who shall have the definite responsibility of preparing and developing an orderly post-war plan for that company.

The second point that I wish to emphasize concerning the check sheet is that it requires the manufacturer to analyze his own present work force. We know perfectly well that there are hundreds of employers today who have no idea how many of their present work force will want to continue or how many will wish to leave the plant the moment the war job is done. An analysis of the present work force discloses the number not desiring to continue employment. By subtracting this number and adding the estimated number of returning draftees, the post-war employment problem of that particular plant is immediately reduced to a known and manageable size. The figures furnished by manufacturers of course are of the greatest help when the post-war employment problem for the community as a whole is being considered. In other words, when fifty manufacturers of Nashua, New Hampshire, have sent in their check sheets, the figures therein can be totalled to answer: "What is the total employment at the present time in the Nashua manufacturing plants and how many will want

employment after the war?" When the total number of people who will take themselves out of the employment market is subtracted from the present total employment and the number of returning draftees is added, the difference will be the number of men and women for whom employment must be somehow provided in Nashua after the war has come to an end.

The third point—and this is really, I think, the $64 question of the CED procedure—is the request for a small figure, just a few digits from the manufacturer: How many people does he expect to be able to employ in the post-war period? Now, if he has been at all affected by the war he can't possibly give an honest estimate of the number of people he can employ after the war without doing some real work and doing some real thinking, and he can't do the work and do the thinking without facing some cold facts, some of them pleasant, and perhaps some of them not so pleasant. He can't arrive at even the most approximate estimate of the employment that he can provide in the community until he has gone over carefully the situation of his company, the status in the market of the products that he manufactures, the changes that have taken place, the changes in product design or in methods of selling, or the development of new competing products.

In other words, the manufacturer in Nashua, New Hampshire, or in any other New England community, who turns in an honest answer to that $64 question, gets started on his post-war planning, and that is the total objective of the Committee for Economic Development. When CED has manufacturers A, B, C, and so on, each started on his own post-war plans, and adds to them 10,000, 20,000, 100,000 American manufacturers each making his own post-war plans, then we shall have the American industrial manufacturer going ahead on a normal, healthy, and wholesome basis.

The Committee for Economic Development has an able staff and has the coöperation of all kinds of agencies,—government, scientific, business, and so on. It is producing a variety of aids to management in post-war planning, and any manufacturer who gets started on working out his own situation will find all of these facilities ready for his use.

I should point out to you that the Committee for Economic Development is convinced that to maintain in the post-war period the volume of employment that we had here in 1940 at the beginning of the so-

called defense program is going to be nowhere near enough. The great increase in national income, the great rise in national debt, the increase in the population, and other considerations make it absolutely essential that post-war employment be much greater than prewar employment.

Mr. Kendall, in describing to the Council at its June meeting this year the post-war plans of his company, said that they had set as their goal an increase of 40 per cent in the production of their mills, and they were figuring what employment would be necessary to produce that 40 per cent more production. To devise the means to win their goal, Kendall Company in its post-war planning has had to study their products, redesign them, and all that sort of thing. They are fully into the job of post-war planning. Many other industries in New England are equally engaged in post-war planning. There is nobody in a position to tell any audience too much about the post-war plans of the individual industries in New England, for the very good reason that most companies feel that it is to their interest not to publicize long in advance their own individual post-war plans. I am sure we all will respect their reasons for holding their plans in confidence.

The Committee for Economic Development is not greatly concerned about the large industries in this country and their post-war plans. No one on the Committee is losing sleep over the post-war plans of General Motors or General Electric, and the rest of them. The great industrial corporations have been post-war planning, probably, since the day before Pearl Harbor. CED's problem is to get the small manufacturer to realize that he, too, must do some post-war planning. Here is the approach that a very substantial but relatively small industry in New England is making to its problem of post-war planning. I think for illustrative purposes it is well worthy of your attention. I will read a statement made to us recently by the president of that concern:

"In our own thinking, we have broken our survey work with our regular accounts down into three groups:

"1. Labor—whether unionized, percentage of increased labor rates, policy in regard to returning soldiers, the backward trend of a shift policy and perhaps weight given to seniority.

"2. Equipment and Manufacturing Facilities—how long it will take to reinstall facilities for prewar products, list facilities adaptable to post-war products, contemplate products capable of manufacture on newly procured equipment, what equipment contemplated will be discarded, what is government-owned.

"3. Sales and Sales Management Policy—to my mind the key because selling is bound to come back into its own sphere of importance and in a great measure dictate what is produced. For your own thinking, as chairman of the Industry Committee, maybe the sales thinking can be headed as follows:

"(a) A survey of old customers with respect to anticipated volume compared with the average of 1940 and 1941.

"(b) A survey of prospective volume with new customers derived through the war effort.

"(c) What has to be done in connection with new lines and research.

"(d) The volume of lines which are being definitely discontinued.

"(e) Whether it is contemplated to take orders with cash deposits before the last ten minutes of fighting, as some are doing, to give an initial backlog of volume.

"(f) A statement of policy in regard to costs and prices.

"(g) Will new capital be required for additional manufacturing facilities?

"(h) The probable effect of competition from concerns who have deserted old lines and gotten into new work on government contracts, which they expect to stay in and hence become competitive."

I think every one who is in manufacturing will recognize in the list perfectly familiar problems, and I certainly would be the last one to suggest that they are simple or easily solved. But I do urge—and this is the message of the Committee for Economic Development—that their consideration be not deferred and postponed or become merely the subject of vague discussion when the board of directors or the management group get together to talk things over.

The experience of the Committee for Economic Development in New England and elsewhere shows up certain obstacles to the achievement of its objective. It seems to me that these obstacles can be listed in the following order:

1. Inertia. We all are familiar with it.

2. Management is too busy with war production and the multitude of problems and harassments that are associated with working for the government.

3. The feeling of some managements that their concerns are too small to be able to assign personnel or to afford to hire outside personnel to work on post-war plans, policies, and programs.

4. The "What's the use?" attitude. The group so reacting is I am happy to say we believe, rapidly diminishing. What their attitude means, I think, is something like this: "Oh, how can we tell what we

want to do after the war; we don't know what our taxes are going to be; we don't know what the government is going to do about this," and so on. I think really all this is more of an excuse than a reason. Whatever happens we know that the economy and the life of the country will go forward. An alert business man will certainly wish to play his proper part in that life and not, so to speak, be left at the post.

The CED's method of organizing local committees appeals to New Englanders. It is in keeping with the New England tradition that local men analyze their own problems and have the power to decide and take action. But the Committees, like all committees, have their weaknesses, especially in the early stages. They are slow to move. When they ask for information from manufacturers, their own neighbors, the responses are very slow in coming in, and the information given is incomplete. In other words, like other pioneer efforts, results are won only by hard work. But every unit of industrial management or business management that is led into planning now is a gain. It is another brick in the wall against the destructive floodwaters of mass unemployment that will surely threaten us in the post-war period. Many times, there is a slowness on the part of management to accept responsibility outside the limits of its own business, a slowness to accept a social responsibility, if you please, or, if that is too broad a term, a slowness on the part of one business management to accept its responsibility to the managements of other businesses. If each unit of management does not do its part to provide employment, then no management will have adequate markets for its products.

There is a tendency also among some business men to confuse their immediate interest with their ultimate interest, their immediate interest perhaps being to save money and avoid commitments, their ultimate interest being the preservation of their enterprise so that they will continue to have a business to run. But despite all hindrances the effort of CED committees must and will go on.

We all know that in every situation there are load pullers and load riders. I am sure that all of us want to be among the load pullers and not among the minority, the load riders. One day there will be an overwhelming rush into post-war planning. I am sure you will agree with me when I confidently predict that those who start now on their post-war planning will not only meet their own situations more success-

fully in the post-war period, but they will make a far greater contribution to the national welfare and the survival of free enterprise than will those who perhaps are too smart for their own breeches, who will wait until they see the end of the war at hand and then will rush to do something overnight.

WATER SUPPLIES FOR AIR RAID FIRES

BY HORATIO BOND*

[*Read September 29, 1943.*]

Air raids as a war practice are going to profoundly affect a lot of things we do in the future. Just how, few people on this side of the water yet realize. I was privileged recently to fly across the Atlantic and spend nearly four months in England seeing what the air raids had done there. This was an assignment given me by James M. Landis, until this month Director of the U. S. Office of Civilian Defense. I was then, and still am, serving the Office of Civilian Defense as a part-time consultant, and also as a consultant to a division of the National Defense Research Committee.

This was perhaps a logical result of the Association's policy to be as helpful as possible to all governmental war agencies. Under instructions of our Board of Directors, members of our staff have been carrying out this policy over a period that dates back many months before war was generally recognized as likely. Our General Manager, Percy Bugbee, is Chairman of an Advisory Council to the War Department on Fire Prevention, and Technical Secretary Robert S. Moulton is serving as consultant to the Stockpiling and Transportation Division of the War Production Board. While these are the principal activities of the National Fire Protection Association's staff, many of our officers and directors, and a very large proportion of the rank and file of members are directly concerned with important war work.

To provide a background of the point of view from which I am speaking today, the National Fire Protection Association is a technical and educational association, organized to promote the science and improve the methods of fire protection and prevention. Many of you are familiar with its function as a standards-making body in the fire field. These standards include the National Electrical Code; the National Fire Codes on Extinguishing and Alarm Equipment and

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on Flammable Liquids, Gases and Explosives; the Dust Explosions Codes; and numerous other standards on building construction.

It is in carrying out a second function of the Association that so many of our members, directors, and staff are devoting time to fire prevention work in wartime. For over a hundred years, in this country there has been gradually built up a recognized science and engineering practice in fire protection and fire prevention. For the last 46 years, the National Fire Protection Association has been a clearing house for the technical information in this field. The work of its members is to secure the proper application of known safeguards against the loss of life and property by fire. Very little of our normal loss, both of life and property, needs to occur in the light of what is known about how fires start and spread. It is no less true that wartime fires can be made much less serious through the application of known information.

I have explained briefly this background of the work of the National Fire Protection Association to make it clear that the National Fire Protection Association is not an insurance organization. So many people have the queer notion that fires are principally a matter of concern to the insurance companies, so that the National Fire Protection Association is often taken for an organization solely of insurance men. Casual contact with some of the standards of the Association might give this impression, as they are used as a basis for the judgment exercised by insurance people in underwriting and in the making of insurance rates. To conclude that the National Fire Protection Association is an insurance or rate-making body is unfair both to the Association and to the bodies which have strictly insurance functions.

A second reason for explaining this background is to show that we are not tackling the fire problems of war starting from scratch. There is a well-developed body of information and a fairly substantial, if not too large, body of people who, if they are listened to, can produce some of the answers to our fire problems of war.

Before discussing water supply problems for air raid fires, I am sure there are a number of things you might like to know about England in wartime.

The period of the worst raids on England ended along in May

1942. Since then, they have been in what they term a "lull" period. However, during the four months I was in England, there were several raids of fair intensity on London proper and in some of the other parts of the country which I personally witnessed. There are alerts very frequently. While these raids are, of course, low in intensity as compared to the blitz raids we have heard so much about in this country, they occur often enough to provide a frequent reminder of the fact that the enemy is only a few miles away and that vigilance is a constant requirement.

For example, practically every able-bodied person has to serve as a Fire Guard. The duty of Fire Guards is to fight small fires. In a large building or a group of buildings, the management is expected to organize what is known as a Fire Prevention Scheme, the purpose of which is to have a sufficient number of persons on duty at all times so that during a raid they may immediately find and attack any fire that may be started by incendiaries. Nearly everyone now knows how to use stirrup pumps, and many are trained in the use of fire extinguishers and small hose.

This is only one of the ways in which you are made to feel the war in England. Even when there are no raids, the war is with you constantly in small ways every day. An item of routine which they have in every home and other buildings (and which we do not have here) is the business of "doing the blackout". This is simply remembering to close the curtains over windows at or about sunset. The newspapers carry the time of the blackout in England much as our newspapers mention the time when automobile lights must be turned on. At night, moving about in completely blacked-out streets gives you no opportunity to forget the war, and this is particularly noticeable through the long night periods in winter months.

You are aware of the nip-and-tuck character of the war effort when you live and work in lights dimmed in order to save fuel. The war intrudes itself in many petty economies. You are urged to use no unnecessary matches and to keep the depth of water in the bathtub below the 5½ inch level.

Everyone is eating in England even if not up to pre-war standards. Americans find most burdensome the greens and potatoes which are the principal items of practically every meal. Most Americans

are surprised to find that coffee and sugar are generally available, though of course they are served sparingly. The load of the war on the people of England has been very heavy indeed. It is an unimpressionable person who can fail to realize how well the country as a whole has done and especially how the coöperation of the individual citizen has helped keep things going.

There has been a lack of materials for the replacement of much of the air raid damage and for certain forms of maintenance. This caused many English friends of mine to remark that they felt their cities looked shabby. By comparison with our American cities I would not have come to that conclusion at all. For example, you will remember having seen pictures in this country of bomb damaged streets in London and other British cities. Practically all of this damage has been repaired, and the London streets right now are uniformly much better paved than those in Boston and other large American cities.

My work in England was greatly expedited and made very pleasant by the fact that the National Fire Protection Association was well known there. Many of the top men in agencies with which I had frequent contact were not only Association members but had been for a long time. This was true, for example, of the head of the Department of Research and Experiment of the Ministry of Home Security; the Chief Technical Officer of the Fire Offices' Committee, which is the leading insurance technical organization; and the chief of the new National Fire Service.

Until the air raids fell on them, it had been a long time since any English city had had a conflagration as we know them in this country. Combustible roofs of wood shingles, which have caused so many of the conflagrations in this country, are simply not used in England. Furthermore, the typical dwelling house in England has an unfurred solid brick wall. In congested areas, dwelling units are usually separated, one from the next, by a brick wall. Commercial buildings are of types of construction pretty much like our own, and it is in these buildings that practically all of the serious fires have occurred.

The most startling thing to a fire-protection engineer is England's freedom from small day-to-day fires. Grass and brush fires are relatively unknown. This low fire frequency is of course due to the

generally high prevailing relative humidity in the country. This explains a good many of the differences in fire practices in England and in the United States and Canada. It explains why, until the war came, English cities had not felt it necessary to maintain strong fire departments or water supplies for fire fighting.

In calculating the size of a municipal water supply for England about the only load which would be taken into account would be the normal load for drinking, sanitary, and other domestic purposes. If the public water system provided any capacity over and above the bare domestic requirements, it was considered to be very nice for the fire brigade. The principle does not appear to have been recognized in England that a public water supply should be designed to give water for both fire fighting and domestic uses. Our practice of figuring capacity of a system as the domestic plus fire fighting demands is of course the result of the great conflagrations in America. We have been encouraged in this country to think rather intensively about private and public water supply arrangements. English experience with large fires and conflagrations dates only from the present war which has brought the water supply problem up for intensive study only since the air raids started.

Fundamentally, there is the same problem of public water supply for conflagrations set by air raids as for conflagrations set from any other source. The supply must be large and reliable. A good place to start thinking about this is to consider first water supplies for industrial plants. We have taken many steps in this country in developing industrial plant water supplies which are doubly important for air raid protection. In laying out a water supply for an industrial plant, an engineer who knows fire protection would try to get at least two separate sources of water, a street connection and an elevated tank, for example. In the last twenty or thirty years, fire protection engineers have laid great stress on the desirability of having an additional storage of relatively large quantities of water in tanks on the ground supplied by fire pumps. The desirability of this has been shown by peacetime fire experience. A lesson of the air raids is that such local storage of water for fire fighting purposes is of prime importance because such water is not lost in the event of breaks in public water mains.

This is a good place to start consideration of public water systems for air raid fires. The same principles must be applied. The British have found that in addition to public water mains there must be ground storage of water in tanks or reservoirs. This must be as near as possible to the building on which the water is likely to be used. Such protection has, therefore, been generously provided throughout all built-up areas. With adequate fire department pumpers, such water supplies can be used even though mains in the public water distribution system are broken. Had these local storages of water been available during the blitz raid, the fire fighters tell me that they undoubtedly could have stopped the spread of fire in many cases and reduced the total area burned over.

In many cities, these ground storage tanks or reservoirs are connected by steel pipe mains which make possible the replenishment of the water supplies from substantially unlimited sources such as a river or other body of water. As a result, therefore, of the air raids, English cities have been provided with two separate water systems.

We must review our practices in the provision of public water supplies, both for fire protection and domestic needs in the light of potential air raid defense. Local storage of water makes good sense for fire fighting in peace or war. Otherwise, our present fire protection practice would not so strongly stress such local storages in industrial plants. It is equally logical to provide local storage in other built-up areas. A number of American cities, notably San Francisco, have underground tanks or cisterns which are available for fire department pumper suction. I would be presumptuous if I said I had the answer to this problem. However, it is one that I have thought about a good deal and I can offer one suggestion as a basis for future study. I would suggest that we build in our cities separate water systems for purely fire fighting purposes. These systems would consist of a large number of individual unit systems, each unit protecting a block or group of blocks. Each of the unit systems gets its primary supply from a gravity tank and a secondary supply from ground tanks or reservoirs. In each unit there would be a system of piping separate from the regular public water system. This system of piping would cover a small area and be provided with section valves much in the same way an industrial water system is laid out. I suspect it might

be best to have these section valves normally closed rather than open. It would then be possible to localize the effect of bomb damage as there would be no wide-spread failure of water in an entire area of the city simply because one feed main is hit by a bomb. Such an arrangement seems to me to have numerous advantages. Sprinklers and standpipes in buildings would be supplied from these independent systems rather than from the public domestic water system. The function of the domestic system would then be to supply water for tank filling purposes only.

The wide use of sprinkler protection is of great importance for protection against air raid fires. As long as incendiary bombs are distributed over a considerable area, you have a type of situation that sprinklers are ideally set up to handle. There is another reason why sprinkler protection should be greatly developed. Sprinkler systems came about because of the extraordinary difficulty of putting water on a fire through the manual use of hose streams. In air raids, the difficulty of using hose streams to fight fires is much greater than normal. In our existing buildings, the only chance we would have of controlling air-raid-set fires would be with every building sprinklered and with strong independent local sources of water such as I have just described.

The one suggested method of providing water supplies for air raid fires is a personal suggestion, and some of the views expressed here should not be considered as officially accepted either by the National Fire Protection Association or the government. I must further apologize for the vaguesness of my proposal as to details. This is partly because I do not know at the moment how these details will work out and partly because for security reasons it does not seem appropriate to go into detail. A friend of mine, an English architect who has been serving the Research and Experiments Department of the Ministry of Home Security in England, was asked to present a paper to the British Institution for Civil Defence last March. He prefaced his remarks by pointing out that there could hardly be a less suitable time than the middle of this war in which to discuss frankly the factors entering into the protection of cities from air raids. These factors, he reminded, have been subjected to intense study by expert staffs on both sides of the conflict during the last three

and a half years. Either side would be delighted to have some summary of information showing what the other is thinking about. I have, therefore, had to offer these suggestions on the basis of matters which are common knowledge.

The suggestions I have made about water supply arrangements for air raid fires apply to our cities as they now exist. Air raids as an instrumentality of war have been tried in this war substantially for the first time. Air raids in World War I were on a negligible scale. Can we picture our present cities standing up against raids of a war a few years hence? Reasonable safety from future air raids can be obtained, I am sorry to report, by no measures short of extensive replanning and rebuilding of our cities.

Time does not permit here developing in detail what the cities of the future will look like but one thing is certain that vastly greater spacing must be provided between buildings. This affects water distribution system design as well as the distribution systems of other utilities. It is likely to increase the cost of some utility distribution systems. The load on water utilities may be materially reduced by local storage of water for fire fighting, and this is likely to be an important compensating feature for these utilities.

Furthermore, I see that our municipal planning agencies will occupy a position of much greater importance in the future. They must be raised from committees which produce advisory plans and be given responsibility and power to make plans and carry them out for the safety of these cities against future air raids.

I have little patience with one point of view that I have frequently run into here which assumes that little of the experience of English cities is valid in application in this country. I do not think that the differences between English and American cities warrant any such assumption. I feel, too, that there is another reason why we should make the most of the lessons the English have learned; that is, that while they held off the enemy, our cities were spared. Had England fallen, and the margin was small, it would have been our cities in which these lessons might have been learned the hard way. We may have to learn them ourselves sometime if we sniff at them and say in a superior way that there is nothing in them for us.

One final word of caution—the war isn't over yet. Its tide may

ebb and flow many times before the final outcome. Alexander de Seversky, aviation expert who has so frequently called the turn in air warfare, says that Germany's most logical next step is to try a knock-out blow in combined air and sea warfare against England. He warns that she has 4,000 heavy bombers for the purpose and an even chance for success. I can report that the British Fire Service also is keenly alert to this possibility. For us here in America, there is also the consideration that in the Orient we are up against an enemy of vast resources and fanatical determination to win.

Discussion

William W. Brush.* Mr. Bond, I would like to ask whether, from what you saw in England, you believe that if sprinklers were available in the buildings it would be necessary to have a storage supply for each building due to the likelihood of the supply system from the street mains, whether it be a separate system, as you have suggested, or the usual system, failing on account of a bomb destroying the water supply pressure at the time that the incendiaries were falling on the buildings.

Mr. Bond. If you have a local gravity tank plus local ground storage tank your chances of having these supplies when a raid occurs are pretty good, providing the system does not stretch out very far from the building hit. The difficulty seems to be in bomb damage to a water main several hundred or thousand yards from the building on fire. There is no question but what sprinklers will hold most fires from incendiaries alone. There is a possibility of damage from high explosives breaking water mains to or in any sprinkler system. That has occurred. But I think you will greatly increase the chances of catching the small fires and controlling them, especially from the incendiaries, if a local water supply is fairly close at hand.

Mr. Brush. I would like to get an idea of what the various individual smaller systems would cover. Would they be, say, in Boston, an area of ten blocks square, and would each building presumably have to have its own storage for the sprinkler system in

*New York, N. Y.

case a bomb did hit that pipe system and destroy it within that area?

MR. BOND. That is one of the points I was vague about, principally because I don't know the answer yet. I don't know how much area these unit systems ought to cover to give a fair factor of safety. There might be independent loops going around four blocks, with one gravity tank, and possibly one ground storage tank for the area. There might be a need for more ground storage tanks; but those are details which I think we have to work out in the future.

MR. BRUSH. From the information you have gained in England, I believe at the present time the water works fraternity in this country should undertake a serious consideration and study of a revolutionary change in our water supply systems, whereby we would set up systems for our local protection.

MR. BOND. We ought to have some plans, at least, for that: They would be very useful, and might be included in the program of "Blueprint Now."

MR. BRUSH. About two years ago I suggested we were probably coming back to the cistern system.

CHAIRMAN CLARK. I suppose our pumping stations would be among the things that you would suggest something be done about.

MR. BOND. I think it would be very difficult to hit with aerial bombs single points such as pumping stations.

E. V. FRENCH. Is there any uniform practice in England regarding underground tanks, or tanks at the top of buildings, or in the vicinity of existing buildings?

MR. BOND. Yes, they appear to have fairly uniform practices. A good many of the tanks are rectangular steel tanks set up in the street,—that is, above ground. Use has also been made of basements where buildings have been wrecked. The basements are cleared. There is usually a good brick wall there, and with some waterproofing and reinforcing those basements may be made into satisfactory storage basins. They have one rather interesting difficulty, which is not surprising, with these tanks of water in the streets. These reservoirs

have to be covered because children fall into them and because they get filled up with rubbish. Where uncovered, they have to be cleaned quite frequently. They are not very deep. They are so arranged that you can drop a fire department suction line into the tank.

CHAIRMAN CLARK. There would not be any trouble from freezing?

MR. BOND. Not in England's mild climate.

HAROLD W. GRISWOLD. Are the tanks the sole obligation of the civic authorities, or are they the joint obligation of the civic authorities and the industrial plants which are protected?

MR. BOND. I seem to recall that those are an undertaking principally of the national government. If an industrial plant provides itself with such protection I rather suspect that the government pays for it.

A MEMBER. Isn't it true that there was not much attention paid to the adequate water supplies and such detail as pumping stations and sprinkler systems?

MR. BOND. Our development of water systems for fire fighting purposes was on a much greater scale in this country and much more thorough than there, because we had had disastrous fire experience that forced consideration of these things on us, which made us get right down and consider how much water was needed not only to furnish water for drinking and sanitary purposes but also to put out fires. In England, the general attitude of the water utility, both public and private, was that if there was any water left over it could be used for fire purposes. They made quite widespread use of automatic sprinklers, particularly in the large industrial properties, much as we do here.

MR. BRUSH. Do you know whether the water engineers of England have given the matter of separate systems very extensive study up to date during the war; and if so, whether we have the means of finding out just what their presentday conclusions are?

MR. BOND. No, I do not. I did not go over there primarily

to study the water supply problems. I wish I had had more time to look into them.

SAMUEL B. MORRIS.* In San Francisco, we have a very extensive system of cisterns constructed after the 1906 fire, in addition to the salt water system and the pressure water system, for fire protection. I would like to ask Mr. Bond whether he considers the system we have in San Francisco of cisterns a rather satisfactory provision for air raid precaution.

MR. BOND. Yes. I mentioned it in my paper as one example of an American city that had already taken a step along the lines necessary for protection against air raids as well as other fires. San Francisco, of course, having gone through a great earthquake and fire, knows the value of more than one water system. There are in San Francisco three separate sources from which water may be taken, —the normal water supply, the high pressure system, and the system of cisterns. That represents the sort of approach that we need to meet air raid fires as well as sweeping conflagrations of a normal character.

CHAIRMAN CLARK. I would like to ask Mr. Morris if these cisterns are covered, and if they have any trouble from freezing, debris, or anything of that sort.

MR. MORRIS. These cisterns are in general of a capacity from 50,000 to 100,000 gallons, and they are completely submerged. There is no problem of dirt, debris, or freezing.

*Palo Alto, California.

WATER SUPPLY EQUIPMENT AND FACILITIES FOR ADVANCE BASES OF THE U. S. NAVY

BY CHARLES T. DICKEMAN*

[*Read September 28, 1943.*]

In this brief paper I shall endeavor to outline briefly the problems we are encountering in the engineering field in the advance areas, and how we are attempting to solve them.

The Bureau of Yards and Docks of the Navy Department, staffed by officers of the Civil Engineer Corps of the Navy, is responsible for the design, construction and maintenance of the naval bases within the continental limits of the United States and advance bases overseas. These overseas bases develop many varied engineering problems in that the advance bases may comprise air fields, with shops for the overhaul of aircraft; fuel storage systems; fuel oil depots to supply the units of the fleet; and supply depots in which are stored ammunition, food, supplies and other materials to keep the fleet in operation. In addition, there are bases for PT boats and larger naval bases where repairs are effected on naval vessels. These bases, ordinarily, must have the facilities for supplying and repairing all ships of the Navy, from the smallest PT boat to the largest battleship, and they must also include not only shops and waterfront facilities but dry docks as well. All of these bases, naturally, are provided with personnel housing, water systems, roads, and facilities for taking care of the wounded, in the form of small or large hospitals, as the case may require.

The solutions to the problems are varied because of the topographical conditions, most of which are not ordinarily encountered within the confines of the United States. The bases may be located on a sandy coral atoll or on a mountainous volcanic island fringed with coral reefs; on the fringe of a desert as in North Africa; in and about jungle areas, such as are found in New Guinea or on the shores of more civilized areas such as Sicily, Italy and Australia.

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Naturally these prevailing conditions present problems that are not entirely familiar to the personnel.

Let me briefly sketch for you the manpower problem. When we were about to enter the war, we were cognizant of the need for organizing skilled workers to carry on the work of constructing overseas bases. Prior to the war, we had constructed our overseas bases through civilian contractors of the United States on the usual cost plus-fixed-fee contracts, but once these areas became active combat zones, they had to be manned by military personnel. To that end, the Bureau of Yards and Docks instituted a recruiting program to organize Construction Battalions. The Seabees have conducted themselves in a most creditable manner and have performed their work overseas to the satisfaction of all concerned. These organizations, recruited principally from the building trades, have been organized into construction units consisting of about one thousand enlisted men and thirty officers. Enlisted men of the Construction Battalions consist of pipe fitters, welders, waterfront workers, plumbers, concrete workers, carpenters, and almost any skilled worker that could be mentioned.

After approximately six weeks of boot training in which they are taught the rudiments of military life, the Seabees go on to an advanced training center where they are welded into a unit and given technical training. This specialized training emphasizes the use of certain types of equipment which they will be required to use when they arrive overseas. They are then sent to one of the three Advance Base Depots, which are located at Davisville on the East Coast, Port Hueneme on the West Coast, and Gulfport on the Gulf Coast. While at these Advance Base Depots, the Battalions are completely outfitted for overseas duty. They are supplied with 600 to 1800 tons of construction material and equipment, comprising all categories, such as welding outfits, cranes, shovels, bulldozers and other units, including all types of tool kits which will be needed in the construction field. The Battalions are also provided with personal gear, canteen sets and necessary cots, bedding and tents, so that they may be self-sustaining.

The time element is also an important factor in the building of advanced bases. In peacetime, engineering parties could be sent into

the field to gather necessary data to engineer the project in the proper manner. However, in these critical times, the situation at the advanced bases is quite different. The limited time does not permit the usual preliminary engineering work, and reconnaissance usually consists only of that which can be furnished by air. Our planning must be done far in advance of the arrival of Construction Battalions at these bases, in fact, we are now planning the 1944 program for bases about which we know practically nothing.

Standardization therefore becomes necessary. It is a simple matter when it comes to construction equipment. However, water, fuel oil, mechanical and electrical installations present a major problem. These installations must be able to function under any climatic and/or topographical condition. For instance, in the standardization of electrical distribution systems for naval advance bases, we have organized standard units and distributing materials from which we can build a unit of almost any size. In one particular instance, because we were unable to wait for delivery of a 500 kw. unit, we shipped 50 and 75 kw. units which were connected in multiple in a loop system. This also provided the added advantage of dispersion.

Shipping is another very important feature to be considered in the fighting of this war. We in the States do not realize the full importance of shipping. At the time war was declared, I was in Africa, and it was not until the need arose for materials and equipment that I realized the great distance that separated New York City, our source of supply, from our receiving point on the Red Sea, a distance of some 14,000 miles. This meant that, at best, a freighter could make only three round trips per year to keep us supplied. In overseas shipments, the matter of weight and cube must be kept to a minimum so that the greatest amount of equipment and supplies will reach the front in the shortest possible time.

An excellent example of this is the device used to overcome the problem of housing at advanced bases. This was solved by the design of the "Quonset Hut" at Davisville, R. I. This Quonset Hut has been universally adopted not only by the Navy but by the Army as well. The Quonset Hut is so constructed that the corrugated iron sections can be nested and shipped in a minimum amount of space.

We are also confronted with the Critical Materials situation and

are constantly on the alert to reduce the consumption of critical materials. A few months ago, in endeavoring to curtail the use of steel in the construction of the Quonset Huts, we experimented with plywood. At the time the plywood hut was to be put into production, we found that lumber had become more critical than steel, and it was necessary to abandon the idea.

So that any strategical emergencies may be met, coördination between the receipt and shipment of materials and equipment to the fighting fronts is important. A great deal of planning is necessary in the procurement of materials and equipment, particularly with the present difficulties in production, in order to allow sufficient time for the assembly of the material for shipment. All of this preparation is necessary so that the men and material can meet at a specified rendezvous and make the initial landing together.

It is to be understood that when construction equipment is shipped, spare parts are included in the original shipment, but because of the severe climatic conditions and the extreme tests to which this equipment is put, it is necessary to replace the spare parts more frequently in order to maintain the equipment in operating condition. This situation has necessitated the establishment of properly located spare parts depots, carrying thousands of items to keep our fighting fronts adequately supplied.

This gives you a brief picture of some of the problems that are encountered at the advanced bases and the many factors that enter into their solution.

WATER SUPPLY AT ADVANCE BASES OF THE U. S. NAVY

BY D. H. BENNETT*

[*Read September 28, 1943.*]

Captain Dickeman has given a picture of the magnitude of the program now being carried on by the CB's of the United States Navy. As he has pointed out, they not only build that part of the base that is normally thought of as a construction job, but they actually land behind or even with the Marines at a site selected by Naval Operations to be used as an advance base. On many occasions, they land on completely unimproved or uninhabited shores, which makes the selection of the camp site and the construction of the camp the first major assignments of the CB's. In many instances, they not only provide facilities for their own personnel but for the personnel of other units operating in the same area.

Advance bases come under two main classifications: (1) Those of a temporary and mobile nature, and (2) the permanent base from which it is expected that other smaller operations will be carried out. Equipment, construction machinery, and housing facilities vary considerably in accordance with the mobility of the base.

With the exception of the fact that all naval advance bases are normally located close to the shore, there can be no typical description of a base site. These sites will vary widely in accordance with the type of work to be carried on at the base. Smaller bases may be built up around a single function such as an air field or a fueling station whereas larger bases may include such functions as loading and unloading facilities, ship repair facilities, personnel replacement centers, hospitals, etc. The information available to the battalion commander as to the topography of the site may be very meager as for some South Pacific Islands; or it may be very complete as for bases located in established cities and towns of allied nations.

Regardless of the size and location of the base, the establishment of an adequate water supply is of primary importance and must be

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accomplished as soon after landing operations as possible. The main sources of water are well known, namely: Water carried to the base by barge or tanker, sea water, rain water, nearby ponds and streams, and well water.

Disregarding the supply of water by barge as particularly expensive and undesirable in that it is very vulnerable to enemy operations, the other sources all require some type of treatment to produce safe and potable water. These treatments consists of three methods: (1) Purification; (2) hypochlorination; and (3) distillation. These three treatments derive their fundamental characteristics from the three types of water available: (1) Turbid and/or amoebic contaminated fresh water; (2) clear fresh water free from amoebic cysts; and (3) salt water. Treatment for the first condition is purification. This consists of both chlorination and filtration. Both treatments are necessary where water is not clear, that is, containing turbidity visible to the eye, or where—though clear—contamination exists including the presence of amoebic cysts or like water-borne organisms. The latter may be rendered harmless by the process of superchlorination with subsequent dechlorination to make the water potable. This, however, is obviously not a practical treatment for large quantities of water and is the recommended treatment only for water in such small quantities as in canteens and lister bags. Filtration in addition to chlorination is therefore an important part of the purification treatment involving flocculation obtained by adding soda ash and alum and then filtering through a sand filter of either the pressure or gravity type.

The second treatment known as hypochlorination does not involve filtration and therefore is not intended for use where raw water is likely to be contaminated with amoebic cysts or like organisms. This treatment is not used unless it is clearly established by the medical officer that the need for filtration does not exist. Filtration is usually required in most sources of water available at tropical bases, and hypochlorination is used mainly for deep well or Northern fresh-water sources where it is less likely that amoebic contaminated water will be found.

The third treatment is distillation. This treatment becomes necessary when the raw water supply is either salt water or such highly turbid water that purification is not practical. It involves considerably

more critical material and shipping space per gallon of water produced than the equipment for either of the other methods of treatment. More fuel is consumed by this method and more man power involved in the operative maintenance. It does, however, when properly handled, produce the safest and most potable water of the three treatments.

When organizing the gear to be shipped with a battalion, the water-treating equipment is considered in terms of systems rather than individual items. These systems are usually based on groups of 250 men or multiples of 250 men, with 10 gallons per man per day for mobile bases and 50 gallons per man per day for permanent bases. By this approach, water systems are shipped complete with pumps, treating units, pipe and storage tanks. However, there are certain types of treating equipment which are so small as to require no additional material. For instance, the Navy has developed a small kit-type water purification unit with a capacity of 2½ gallons which is issued in considerable quantities to each battalion for the use of small groups of men in the field and also during the stages of initial landing.

In conclusion, it might be well to point out the important part that an ample water supply plays in building and maintaining the morale of the men in the field. Not only is good drinking water a vital necessity, but sufficient water for bathing and laundering should also be available. At first, the figure of 50 gallons per man per day may seem high in comparison with the per capita consumption of many cities. However, personal cleanliness has always played an important part in keeping Navy morale at the high standard that it has always maintained.

The enemy has also attached great importance to water supply, and it is a matter of official record that there have been repeated instances where enemy aircraft make every attempt to destroy the water system before any other part of a base is attacked. Water purification units moving in truck convoy have been repeatedly singled out for attack by enemy aircraft, in preference to any other type of vehicle. The enemy seems to feel that if the water purification unit can be destroyed, the truck loads of ammunition and combat units will be of small use to men who have been previously incapacitated by waterborne diseases.

Much credit should be given the water works engineers and water equipment manufacturers for the important part they have played in making it possible for the Army and Navy to have a safe and adequate water supply at many points which without their help would have been unattainable.

BROMINE AND CHLORINE DIOXIDE AS WATER DISINFECTANTS

BY JOSEPH A. McCARTHY*

[*Read November 18, 1943.*]

BROMINE

There is little mention in the literature of the use of bromine as a bactericide in water. Tanner and Pitner (1) report that less than 0.25 ppm of bromine killed *Esch. coli, Eb. typhosa,* and streptococci in 15 to 30 seconds. Spores of aerobic bacteria required 40 to 220 ppm at pH 3.5 to 4.0, and 100 to over 450 ppm at pH 6.8 to 7.2. A German report (2, 3) states that when 4 ppm of bromine was added when a swimming pool was filled, and a residual of 0.2 ppm was maintained thereafter by addition of bromine, the water remained free of *Esch. coli.* There have been rumors of similar use of bromine in pools in this country, but no published reports appear to be available. Beckwith and Moser (4) studied the effectiveness of chlorine, bromine, and iodine against soil bacteria and *Esch. coli* in tap water, for periods up to 60 minutes. They found the three halogens equally effective against soil bacteria, but considered bromine the most effective of the three against coli under the conditions of their experiments.

The reported increased production of bromine in the United States as a by-product of various war plants, together with the restrictions in the use of chlorine, led us to an investigation of the comparative effectiveness of the two chemicals, which included work on pure cultures, generally of *Esch. coli,* both in dilution water and in river water, of the normal bacteria in a polluted river water, and of sewage. Each group of experiments was repeated until a sufficient number of agreeing results was obtained, and all results given represent from 3 to 12 runs. In every case, the amount of bromine is recorded as the equivalent of chlorine on a molecule to molecule basis, and the actual weight of bromine therefore would be approximately 2.2 times the stated amount.

*Chief of Laboratory, Lawrence Experiment Station of the Massachusetts Department of Public Health.

Preliminary work showed no difference in the action of solutions prepared from pure bromine and equivalent amounts of NaOBr, and the experimental work was therefore conducted with the hypobromite. Determinations of halogen content were made by titration against N/80 thiosulphate. Attempts to determine bromine residuals with orthotolidin gave flash readings, which faded almost immediately, and which were generally much below the amount shown by titration. We were unable to find any fixed mathematical relation between the two methods. Bromine in great excess will give a more nearly permanent orthotolidin color, but the amount indicated is still much below that shown by titration.

Destruction of Pure Cultures of Esch. coli. In tap water to which had been added a 24-hour pure culture of *Esch. coli* to give a concentration of about 10^6 bacteria per 100 ml, the chlorine demand was practically zero. Chlorine and bromine were approximately equally efficient as bactericides and less than 0.5 ppm of either gave a total kill in 15 minutes.

Similar cultures were added to river water to give a concentration of 10^7 bacteria per ml; the 10-minute chlorine demand was about 0.9 ppm. Chlorine was far more effective than bromine when 0.5 ppm of each was added, especially in periods of one hour or longer, and the effect of the two was about the same with 1.0 or 2.0 ppm. Table 1 shows the per cent of bacteria destroyed.

Effect on River Water. Merrimack River water has a 15-minute chlorine demand of about 1 ppm and an average coliform content of about 10,000 per 100 ml. Chlorine and bromine were added in parallel

TABLE 1—DESTRUCTION OF PURE CULTURES OF *Esch. coli* BY CHLORINE AND BROMINE.

Bactericide	PPM*	Per Cent of Bacteria Killed		
		15 Minutes	1 Hour	24 Hours
Chlorine	0.5	30	99.66	100
Bromine	0.5	10	10	10
Chlorine	1.0	99.64	100	100
Bromine	1.0	100	100	100
Chlorine	2.0	100	100	100
Bromine	2.0	100	100	100

*Chlorine equivalent.

in concentrations from 0.20 to 4.0 ppm. Samples were taken after 15 minutes, 1 hour, and 24 hours of contact; in every case plates and fermentation tubes were inoculated immediately after the samples were taken to stop further action of the halogens. It was found that concentrations of bromine of less than 0.5 ppm had little or no bactericidal

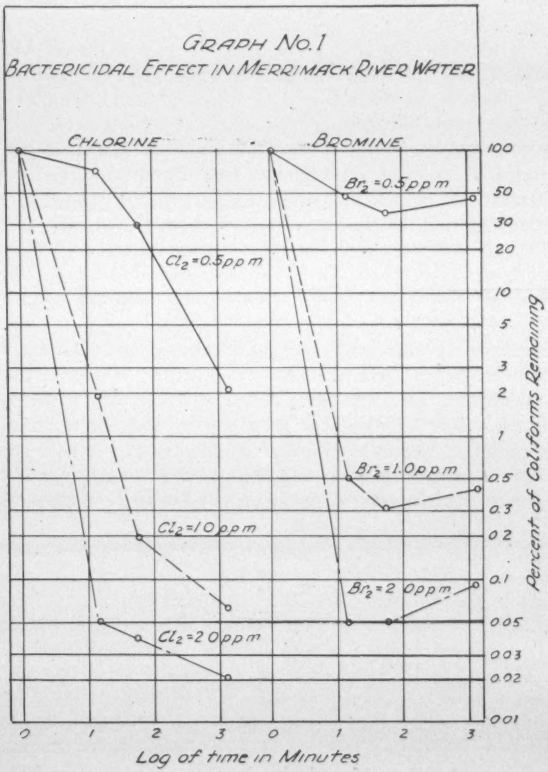

FIG. 1.

effect, although similar concentrations of chlorine showed a fair kill, especially after 24 hours; concentrations above 2.0 ppm of either element effected almost complete immediate destruction of bacteria. Therefore, the greater part of our work was carried on using concentrations of 0.5, 1.0, and 2.0 ppm. Figure 1 shows the average per cent of coliform bacteria killed in a dozen runs. The concentration of coliform bacteria in a control for each run was determined after 24 hours; in almost every case, a slight reduction was shown, which was too insignificant to affect materially the results of the experiment.

In all three concentrations, the bromine in 15 minutes proved slightly more effective than the chlorine; at 1 hour the chlorine kill was slightly better than that shown by bromine; and at 24 hours, the superiority of chlorine was even greater. The bactericidal action of the chlorine was continuous, while the portions treated with bromine showed a slight but definite increase at 24 hours as compared to 1 hour.

The pH determinations on the samples generally showed slight change, from about 6.7 to 6.8 or 7.0 after the addition of chlorine or bromine, but this should not have had any material effect on the bacteria.

Plate counts were made on agar incubated at 20°C. for 4 days, and on litmus lactose agar incubated at 37°C. for 24 hours. The effect on the counts shown by the two halogens is very much the same as that on the coliform index: the reduction by bromine is equal to or greater than that shown by chlorine at 15 minutes, but with comparatively little further effect at 1 hour, and a definite increase at 24 hours; while the chlorine in general showed a continuing reduction. Table 2 gives the average bacterial counts.

Disinfection of Sewage. The disinfecting effect of chlorine and bromine on settled domestic sewage was investigated by adding the halogens in parallel concentrations, with samples taken 15 minutes, 1 hour, and 24 hours after treatment, and immediately inoculated. The sewages used had a 5-minute chlorine demand of from 15 to 18 ppm. Although chlorine showed considerable bactericidal action in 15 minutes, bromine effected no reduction in bacteria except in prohibitively high concentrations; therefore the 15 minute figures are omitted from this report.

As shown in Figure 2, chlorine in concentrations equal to about

TABLE 2—DESTRUCTION OF BACTERIA IN CANAL WATER* BY CHLORINE AND BROMINE.

Bactericide	Concentration ppm	Time	Agar—20°C. 4 days	Bacteria per ml. Litmus Lactose Agar— 37°C.—24 Hours Total	Red
Chlorine	0.5	15 minutes	10400	73	32
		1 hour	11000	44	12
		24 hours	10000	44	0
Chlorine	1.0	15 minutes	640	16	6
		1 hour	380	15	1
		24 hours	190	15	0
Chlorine	2.0	15 minutes	56	10	0
		1 hour	28	5	0
		24 hours	21	5	0
Bromine	0.5	15 minutes	5800	110	44
		1 hour	1800	100	20
		24 hours	9000	1800	0
Bromine	1.0	15 minutes	820	20	10
		1 hour	240	16	0
		24 hours	560	260	0
Bromine	2.0	15 minutes	44	10	0
		1 hour	44	9	0
		24 hours	150	140	0

*The raw-water count was 4,000 colonies on agar in 4 days at 20° C.; and 310 colonies in litmus-lactose agar in 24 hours at 37° C. of which 160 were red.

104% of the 5-minute demand reduced the *Esch. coli* index of the sewage from 10^7 to 10 per ml in one hour, while the amount of bromine required to reach the same figure was about 350% of the demand. In 24 hours, chlorine equal to 100% of the 5-minute demand reduced the *Esch. coli* index to 0, that is to the level of *Esch. coli* present in 100 ml portions only; but the concentration of bromine necessary to accomplish this reduction was about 390% of the demand.

It will be noted from Figure 2 that the tendency with bromine treatment to show higher numbers of bacteria in 24 hours than in one

GRAPH No. 2
REDUCTION OF COLIFORM BACTERIA IN SEWAGE

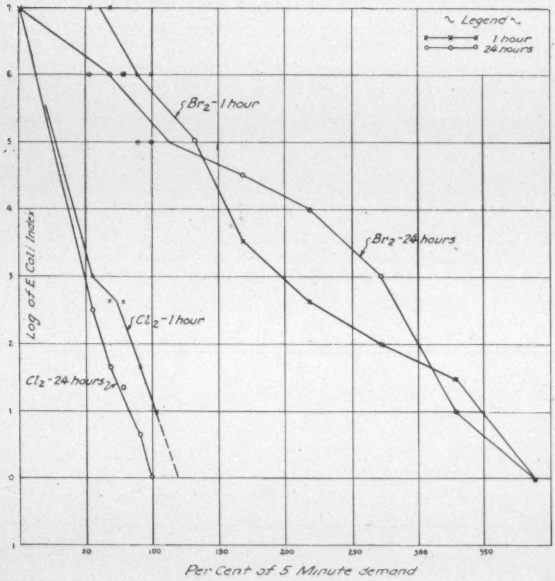

FIG. 2.

hour in the intermediate concentrations, previously shown in the river water experiments, was again demonstrated in the sewage work.

Conclusions. The bactericidal action of bromine is largely a function of the chlorine demand, or the amount of organic matter present; this organic matter affects bromine to a much greater degree than it does chlorine.

Against pure cultures in sterile tap water where the chlorine demand is negligible, bromine is nearly as effective, molecule for molecule,

GRAPH No. 3
EFFECT OF CHLORINE DEMAND ON AMOUNTS OF CHLORINE AND BROMINE NECESSARY FOR TOTAL KILL OF ESCHERICHIA COLI IN 24 HOURS

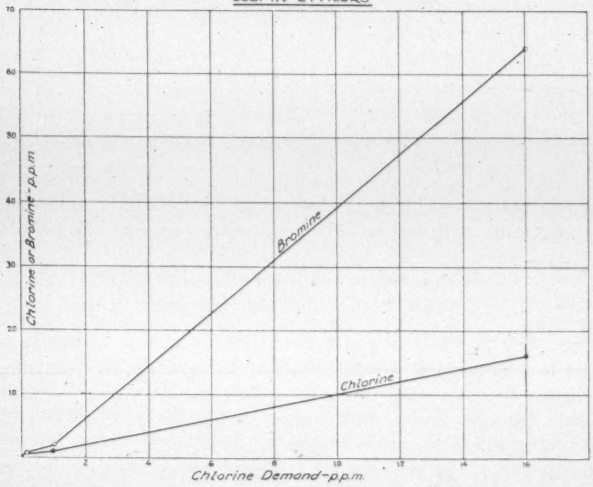

FIG. 3.

as chlorine; in river water two molecules of bromine have about the same effect as one of chlorine; in sewage, at least four molecules of bromine are required to equal the effect of one molecule of chlorine. Figure 3 shows the effect of chlorine demand on the amounts necessary for a total kill of *Esch. coli.*

Bromine has a flash effect on bacteria: in any reasonable concentration the kill in 15 minutes is as great as in 1 hour or 24 hours; in fact, in many instances, more bacteria can be found after 24 hours of contact than after 1 hour. The 15-minute effect of bromine is roughly equal to that of chlorine, but there is little or no residual effect like that produced by chlorine.

Concentrations of bromine sufficient to give a residual test with orthotolidin are generally sufficient to effect a practically complete

kill of bacteria, but further killing effect disappears practically as soon as does the orthotolidin color. The amount of bromine necessary to produce a positive orthotolidin test is considerably greater than the amount of chlorine required.

The use of bromine as a bactericide seems practicable, but at the present prices of the two halogens, the use of bromine would be vastly more expensive than that of chlorine.

Chlorine Dioxide

Sodium chlorite is finding valuable application as a bleaching and oxidizing agent (5). Chlorine dioxide can be formed from sodium chlorite by treatment with acid or chlorine as shown by the following two reactions:

$$5NaClO_2 + 4HCl = 4ClO_2 + 4NaCl + 2H_2O$$
$$2NaClO_2 + Cl_2 = 2NaCl + 2ClO_2$$

Since this agent is in rapid development as a replacement for chlorine in bleaching, it seemed worthwhile to study its effect as a bactericide. The first work was with sodium chlorite, itself an oxidizing agent. Results proved that without activation of the ClO_2, the chlorite failed to kill in concentrations up to 12 ppm.

In the rest of the experiments, the dioxide was activated by various methods: (1) by the reaction of four molecules of sodium chlorite and one of sodium hypochlorite; (2) by passing gaseous chlorine into a solution of sodium chlorite; (3) by acidifying chlorite solutions with sulphuric acid; and (4) by adding alkali to solutions containing chlorite and hypochlorite to give a pH of 11 or 12, and then adding an excess of sodium bicarbonate. Blowing the resulting chlorine dioxide with air into distilled water gave sufficiently pure solutions, the strength of which was determined by titration against N/80 thiosulphate.

It was also found possible to generate chlorine dioxide by adding sodium chlorite and sodium hypochlorite in proportions of 4 to 1 direct to the water being treated. The method of activation made no difference in the results obtained.

Effect on Polluted River Water. Comparisons of the bactericidal effect were made by addition of equivalent amounts of chlorine and

chlorine dioxide to polluted river water, and to suspensions of pure cultures of *Esch. coli* in river water and in tap water. Contact periods from 10 minutes to 24 hours were studied, and in every case plates and tubes were inoculated immediately at the end of the period.

In periods of less than one hour, chlorine equivalent to about one-half the chlorine demand effected considerable reductions in coliform bacteria, and when applied in amounts slightly in excess of the chlorine demand gave a practically complete kill in 15 to 30 minutes. Plate counts showed corresponding reductions. Chlorine dioxide in reasonable amounts in these short periods of contact showed practically no reduction in coliforms and much less than chlorine in other bacteria. The greater part of our work, therefore, was based on contact periods of one hour and 24 hours. Table 3 shows typical results of a short contact run:

TABLE 3—DISINFECTING EFFICIENCY OF CHLORINE AND CHLORINE DIOXIDE.

Sample and Bactericide		Bacteria per ml 4 days 20°C.	24 hrs.—37°C. Total	24 hrs.—37°C. Red	Coliform Index
River water (chlorine-demand=0.8 ppm)		4500	250	100	1000
Chlorine applied:	0.5 ppm	560	65	0	10
	1.0 ppm	120	65	0	0
	2.0 ppm	120	50	0	0
Chlorine dioxide applied:	0.5 ppm	3900	145	10	1000
	1.0 ppm	3100	190	60	1000
	2.0 ppm	700	80	2	1000

In experiments on river water using one-hour contacts, the effect of chlorine dioxide was about equal to that shown by one-fourth as much chlorine. The river water had an average chlorine demand of approximately 1 ppm. In no case did less than 2.0 ppm of chlorine dioxide show any reduction in bacteria; 2.0 ppm gave an average reduction of 90% in coliform bacteria and 85% in 24-hour plate count. Chlorine in concentrations of 0.5 ppm effected a reduction of 90% in coliforms and 91.6% in the plate count; chlorine in amounts equal to the chlorine demand showed a reduction of more than 99.9% of the coliforms and 96.0% of the plate count. Concentrations of 1.5 and 2.0

ppm gave a practically total kill of coliform bacteria, and showed reductions of 96.4 and 98.6% in the plate count.

Figure 4 shows a comparison of the reductions effected.

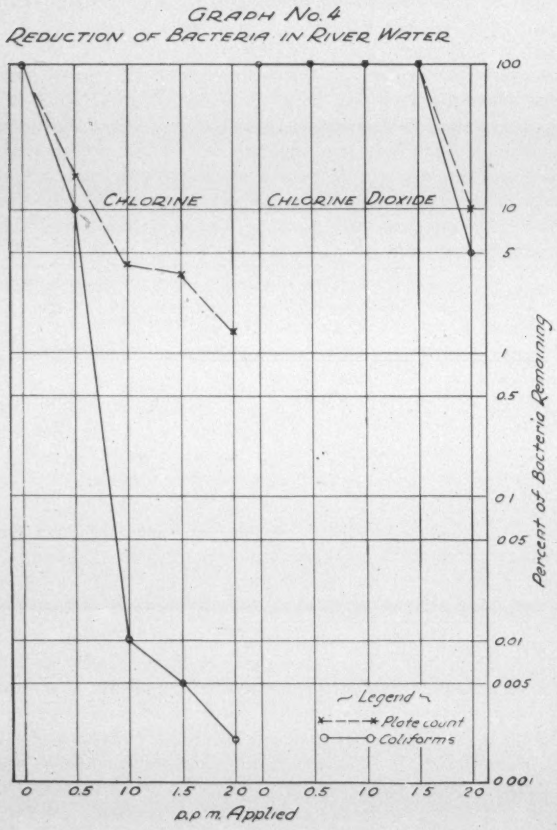

FIG. 4.

Destruction of Pure Cultures. In the treatment of pure cultures of *Esch. coli* in waters with less chlorine demand than river water, chlorine dioxide compared much more favorably with chlorine, especially after a one-hour contact. The demand of the suspensions tested ranged from 0.10 to 0.60 ppm. In the treatment of the suspensions with demands of not much above zero, 0.5 ppm of chlorine dioxide showed complete destruction of coli in one hour. On the other hand, in the treatment of a suspension with a demand of 0.6 ppm, one part of dioxide gave a negligible reduction in one hour, and only about 99% in 24 hours. The average reduction shown in all of the runs with 0.5 ppm of dioxide was 91.8%; in practically every case 2.0 ppm showed practically complete kill in the same time.

With chlorine, however, the only suspension that was not completely killed in one hour was one with a demand of 0.6 ppm, and even in this case, the reduction was over 99.0%. The average for all runs was 99.98%. One part per million gave a practically complete kill in every run.

Figure 5 shows the average reductions effected by the two agents in pure cultures in one hour.

Contact for 24 hours with chlorine dioxide showed little or no additional reduction as compared with one-hour periods, except where the amount added was so great that the residual at the end of one hour equalled or exceeded the original chlorine demand. Chlorine practically invariably showed accumulative killing action.

Testing with Orthotolidin. Although our attempts to use orthotolidin for control work with bromine were hardly successful, it was found quite possible to employ this reagent with chlorine dioxide: the values indicated were somewhat less than those given by titration, but the ratios between the two values were quite definite, and sufficiently close for routine work, provided that care was taken to add enough reagent to make the mixture in the test tube definitely acid; the same effect could be obtained by adding additional hydrochloric acid. The quinone color did not fade, as in the case of bromine; on the contrary, it was found that the maximum color did not develop sometimes until as much as 80 minutes had elapsed; but the maximum was generally observed in 15 to 25 minutes, as compared to 5 to 10 minutes with chlorine.

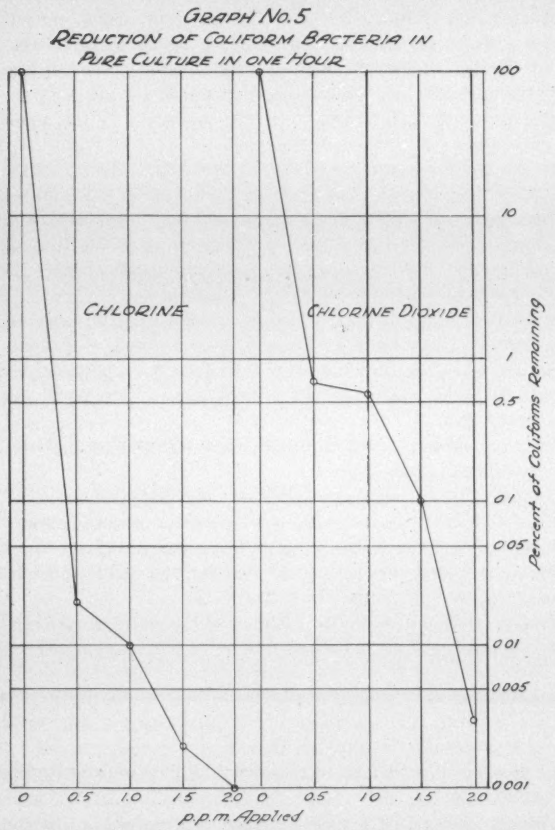

FIG. 5.

Effect of Adjustment of pH. Chlorine dioxide is generally most effective as a bleaching or oxidizing agent in acid solution. Therefore several runs were made both with river water and with suspensions of

bacteria at lowered pH values, and one run each at a pH of about 10. In general, the bactericidal value was not changed, although in one isolated instance the dioxide showed considerably more reduction in bacteria at pH 4.6 than at values from 6.5 to 2.5.

Work in Other Laboratories (6). Through the coöperation of the manufacturers of chlorine dioxide much of this work was paralleled in their research laboratory, and here also it was found that in waters with any considerable amount of organic matter, chlorine dioxide is much less efficient, molecule for molecule, than chlorine; but that as the chlorine demand diminishes, the dioxide approaches chlorine in bactericidal value. It was also found that in several waters, which gave definite chlorphenol odors and tastes after treatment with chlorine, treatment with enough chlorine dioxide to effect satisfactory bacterial reduction did not impart such tastes or odors.

Conclusions. Chlorine dioxide can be used as a bactericide but, except in waters with extremely low organic matter, is much less effective than chlorine in equivalent concentrations. The comparative efficiency of the dioxide increases as the chlorine demand of the water being treated decreases.

Chlorine dioxide has less residual effect than chlorine.

The method of preparation of the dioxide has no effect on the bactericidal value, nor does the pH of the water being treated.

Chlorine dioxide seems to have less tendency than chlorine to produce chlorphenol tastes.

Chlorine dioxide residuals can be satisfactorily tested with orthotolidin.

Summary and Acknowledgments

The efficiency of bromine and chlorine dioxide in the destruction of bacteria has been compared with that of chlorine.

Neither agent is as effective as chlorine, but either could be used as a bactericide.

Both agents are more affected by the organic matter in the water than is chlorine, and neither agent has nearly as much residual effect as chlorine.

The author wishes to acknowledge the valuable suggestions and aid concerning the formation and use of chlorine dioxide given by

Messrs. J. F. Synan, J. D. MacMahon and G. P. Vincent of the Mathieson Alkali Works (Inc.), and the painstaking efforts of Nerses Dermarderosian, Alden S. Cook, and Barnet L. Rosenthal, Junior Chemists at the Lawrence Experiment Station.

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FAILURE OF LOWER RESERVOIR DAM, BELFAST, MAINE

BY J. ELLIOTT HALE*

[*Read November 18, 1943.*]

Introduction. If we were to review the record, we should find that occasionally it seems to be the fate of the water works fraternity to experience a catastrophe that occurs so quickly that it is hard to understand what took place and how it actually happened. Such a catastrophe happened on Sunday morning, October 17, 1943, at the pumping station of the Belfast Water District at Belfast, Maine.

History of Water District. It is not possible to present a true picture or enable you to grasp the significance of this disaster without first giving a brief history of the Water District and of the events that led up to that eventful Sunday morning.

According to the "History of the Belfast Water District", published in the August, 1931, issue of the Journal of the Maine Water Utilities Association, there was considerable agitation, in 1875, in the community for a water supply, and the city bought Muck Pond or Kirby Lake. In 1885 and 1886, the need was again discussed. On October 26, 1886, the people voted to have a water system. The Maine Legislature of 1887 granted a charter to the Belfast Water Company, and actual construction was soon started on the so-called "Lower Reservoir Dam" across the Little River. A power house containing a Deane duplex power pump connected to a turbine water wheel and a Deane steam pump were also constructed. The water was pumped through the distribution system to a 237,000-gal. standpipe located on Wilson Hill in back of Kirby Lake.

In 1915, two rapid sand filters, coagulation basin, clear water well, and wash-water tank were built. The Upper Reservoir Dam of arched concrete, 234 ft. long and 25 ft. high, was also constructed at this time. The capacity of this reservoir is about 157 mg.

An act to incorporate the Belfast Water District was passed by

*Acting Director, Division of Sanitary Engineering, State Bureau of Health, Augusta, Me.

the 1919 Legislature. During the following October, the entire plant was purchased from the Belfast Water Company at a cost of $163,000. Since that time, new pumps and other equipment have been added. The turbine water wheel furnishes power for six or seven months of each year. During the rest of the time, power is purchased. The amount of water pumped is about 520,000 gpd.

Rainfall. During the early fall months, Mr. Ramsdell, the Superintendent, like any good water works man, had started to put the plant into shape for the winter, but there were still a few unfinished jobs. For some unknown reason, the conventional so-called "line storms" did not occur in any great force during that period of change-over from summer to fall. These storms were delayed until the second week in October; then it rained all or part of each day for the next three weeks. On checking the records for that month at the Gardiner Water District, Gardiner, Me., a rainfall, not exceeded for 65 years, of 7.26 in. was recorded. The average rainfall at this station for the past 103 Octobers was 4.06 in. Portland reported 3.27 in. for October 16th and 17th. Augusta reported 3.27 in. and Rockland 5.8 in. for these same days, while at Belfast it was reported that 4 in. of rain fell in three hours on the morning of October 17th.

The watershed of about 16.4 sq. miles above the two dams is very quick. During the morning of Sunday, October 17th, the water level in the lower reservoir rose at the rate of about 1 ft. per hour until at 9:45 a.m. a wall of water 80 ft. long and 6½ ft. high was going over the crest of the dam. A rough estimate of this amount of water is about 5,560 cfs or a little more than 41,700 gal. per second.

A short distance below the dam the river narrows as it passes under a bridge on U. S. Route 1. The span of this bridge was about 31 ft., but the granite block abutments protruded into the water about 30 or 40 ft. on each side. This passageway tended to restrict the large flow of water, causing it to run over the top of the road and bridge. Another cause of high water at the bridge was due to the tide which at that time of day was coming in. Normally there is a rise and fall in the tide of about 8 ft. at the foot of the Lower Reservoir Dam.

Mr. Ramsdell, anticipating some trouble from a possible extra high tide due to high winds, was at the pumping station during the entire morning of October 17th. He had examined the bridge and was

calling the Sheriff to advise that it was unsafe when he looked out the office window and saw the first rocks go off the west or farther abutment on the dam. During the next five to twenty minutes things began to happen. The Superintendent and his pump operator immediately pulled the switches and closed important gate valves but not before they were standing hip-deep in water. Mr. Ramsdell describes the events as follows: "The wall of water going through the break at the far end of the dam went downstream until it hit the bridge and abutments. It was checked for a little while and then some of the water turned and headed back upstream on the pumping station side, entirely engulfed the coagulation basin and filter plant, flooded the pump room floor to a depth of more than five feet and finally hit the back of the near abutment and splashed over it. After a momentary check in the flow of water, the bridge and parts of the stone abutments were carried away and then the water gradually subsided." The water stayed in the station about 20 minutes, but by that time the damage had been done. Three electric motors and the Turbo-generator set were put out of commission; the coagulation basin and filters were flooded; and the station floor and equipment covered with mud, leaves, and other debris. The water in front of the dam finally receded to a point about 5 ft.

LOWER RESERVOIR DAM, PUMPING STATION, COAGULATION BASIN, AND FILTER HOUSE OF BELFAST WATER DISTRICT, LOOKING UPSTREAM AFTER THE FLOOD.

below the intake pipe to the coagulation basin. See the accompanying figure.

Construction of Dam. On referring to the "History" section of this report, you will note that the dam was built in 1887. It was about 15 ft. wide at the base and 5 ft. wide at top of the spillway, 25 ft. high, with a spillway length of 70 ft. and a total length, including abutments, of 175 ft. It was of masonry construction consisting of large granite blocks held in place by their own weight and held together by a bond of smaller stones and natural cement. The west or far abutment from the station was not keyed into the bank. Construction at this point was very poor. Many smaller rocks were used that were held together by cement. To provide a slight slope on the upstream side of the dam, the large granite blocks were laid with a slope from front to back so that the water would have a tendency to lift them up and not push down as they should in a gravity type dam. About 60 ft. of the spillway to an average depth of 10 ft. was washed out.

Emergency Measures Used. Shortly after the dam went out, the Superintendent called the writer on the telephone and requested a chlorinator to use on the emergency supply from Kirby Lake, the originally contemplated source of supply. The writer called Earle Tibbetts, District Sanitary Engineer of the State Bureau of Health at Farmington, to proceed with a chlorinator at once to Belfast. We also got in touch with Mr. Anthony of the Augusta Water District requesting that he stand by with an emergency pumper. After arriving at Kirby Lake, we connected our emergency chlorinator to a fire pumper already there and within 4½ hours after the dam went out we were again pumping safe water into the distribution system. The 800 ft. of fire hose were heavily chlorinated for a period of about 30 minutes. A residual chlorine content of not less than 0.4 ppm was maintained while using this emergency source of supply during the next 72 hours.

Anticipating the need of a pumper for several days, it was decided to use the unit from the Augusta Water District, and before 5 p.m. the pumper arrived, was connected to the suction and discharge pipes, and the chlorinator changed over. In the meantime, at the pumping station some of the mud and other debris had been cleared away, and workmen were busy removing the smallest of the electric motors to be dried at Bangor. On Monday evening, this motor was back and re-

connected. On Tuesday, further work was done to clean the filters and coagulation basin. Arrangements had been made with the State Office of Civilian Defense to bring a skid-type fire pumper to Belfast. This was set up on the east or near abutment to act as a low-lift pump to bring the water from the, now calm, reservoir to the coagulation basin. This unit was started on Wednesday afternoon, the coagulation basin was filled, and the filters and pumps were started. The chlorinator was set to give a residual of at least 0.3 ppm after the usual 10-minute reaction period.

Office of Civilian Defense Functions. After Mr. Ramsdell called the Sheriff, he notified radio station WLBZ at Bangor, to broadcast a warning to the people in Belfast to conserve the remaining water supply and to boil all drinking water. The auxiliary firemen and police were called to duty, and air raid wardens were asked to make a house-to-house canvass to advise all consumers to boil all water and use it with care.

The auxiliary firemen, with the help of the regular volunteer group, laid about 800 ft. of hose from the shore of Kirby Lake to the nearest hydrant and also manned the fire pumper. The auxiliary police directed traffic around the washed-out bridge and on the many streets and roads that were washed out or had culverts or bridges damaged. The Mutual Aid System of the Maine Water Utilities Association functioned very satisfactorily during the emergency.

Future Plans. Until a new concrete dam can be built farther upstream, the break in the present dam will be repaired so that the water will be raised about 3 ft. This will make an easier lift on the suction pipe to a new electric-driven low-lift pump which is to be installed and housed on the east abutment. This should suffice for the winter or until more permanent measures can be taken. Meanwhile the rest of the plant will be operating as usual. The buildings have been cleaned, the motors dried, and the pipe system repainted.

Everything was done so quickly and efficiently that many of the townspeople remarked, "It is hard to realize that such a great loss has occurred with such little or no inconvenience to us". For this they may thank the suprintendent and his crew for their resourcefulness, the excellent coöperation of the Water Works Mutual Aid System, the Civilian Defense units, and the District Engineer of the State Bureau of Health.

APPLICATION OF THE PITOMETER TO WATER DISTRIBUTION SYSTEMS

BY E. SHAW COLE*

[*Read December 16, 1943.*]

When Henri Pitot in 1730 made experiments with a bent glass tube in the Seine River he laid the basis for claims to one of the most unique inventions in history. His discovery that the height to which water rose in his tube was proportional to the square of the velocity of the stream was basic, and like Newton's laws one of the few clearly original discoveries in science.

Two hundred and thirteen years ago there were few applications of this simple principle by which the velocity of flowing water could be measured without a measurement of time and except for improvements by Darcy, another prominent French engineer, some one hundred and twenty-five years later, little was done with this invention until late in the last century. As late as 1890, one of the outstanding engineering authors said of a crude sketch of the Pitot tube appearing in his text book: "Pitot's tube has been but little used and is regarded as an imperfect instrument for velocity determinations."

New England, contributor to so many scientific discoveries and developments, was the scene of the earliest Pitot tube work in this country. Such outstanding engineers as Hiram F. Mills, John R. Freeman, and Richard A. Hale were measuring flows in feeder penstocks at Lawrence, Massachusetts, as early as 1877, and in 1899 Freeman published his classic paper "Experiments Relating to Hydraulics of Fire Streams." Mills' early measurements, which were not generally known until 1902, were the forerunners of extensive experiments and uses during the 1890's. In that period, the importance of accurate and inexpensive water measurements, particularly in the closed conduits of water works systems, stimulated the independent use of various types of Pitot tubes.

As reported by Edmund M. Blake of Boston in the 1906 Journal

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of this Association, Dexter Brackett in 1881 introduced the English Deacon meter into the Boston system for the study of flow in closed conduits. This meter used one of the oldest metering principles which, incidentally, is currently being revived for various applications, such as rate of flow indicators on meter testing tanks, but it was a large and expensive meter designed for permanent installation. In 1896, it became necessary for the founder of our Company to conduct waste investigations in Terre Haute, Indiana, where the size and cost of the Deacon meter prohibited its use. This then was the stimulus for the development of the Pitometer, a portable and accurate type of Pitot tube which can be inserted into a pipe under pressure to measure velocity at any convenient point. This in turn became the basis for the Pitometer System of water waste detection and control known as the Pitometer Survey. Those of us who use a Pitometer continually are constantly impressed by its simplicity as well as its accuracy and reliability, which is aided by the reversibility of its orifices. In field work, this is an invaluable feature, for it not only permits accurate measurement of the flow in either direction, but it permits a zero check of the instrument itself without shutting down the pipe line. How often do we say of instruments "Maybe the darn thing isn't working." With a reversible instrument this can be checked in an instant.

After nearly forty-five years of application in water distribution systems, three separate and well known types of survey have been developed according to need, with Pitometer flow measurements the essential feature in each one. These are known as the Pitometer Water Waste Survey, the Trunk Main Survey, and the Water Distribution Study. The basis for each is an accurate determination of the flows at critical points in the distribution system so that the facts regarding consumption and flows are first known. This is in accordance with the procedure in any engineering or scientific problem where the facts are collected first and then analyzed and interpreted.

Water Waste Surveys. The war has reemphasized the necessity of water conservation, and extensive campaigns are now under way for the elimination of water waste as well as all other types of waste by public utilities. The splendid packet recently published by the American Water Works Association is an excellent presentation of the problem and one that should be read and studied by every water

works man. In the section covering underground leakage, however, two types of leak investigations are discussed without differentiation. These are the "Listening Survey" and the "District" or "Pitometer Water Waste Survey." I would like to take a minute to show the difference and relation between the two. So-called listening surveys are and have always been an important part of the maintenance operations of any well-run water works department since the organization of the first leak patrol in London, England, prior to 1870. The inspectors in this patrol carried a cane with a metal rod at one end and an aquaphone at the other. With this they touched all connections to the main, such as valves, hydrants, and services, and if suspicious sounds were heard, efforts were made to locate a leak with varying success. Since the aquaphone there have been many other types of sound intensifiers, such as the geophone and the radio leak locator. One of these should be used as a routine part of the maintenance of the water works distribution system.

Pitometer Water Waste Surveys on the other hand are conducted by engineers trained in this particular field and should not be confused with the listening survey. The Pitometer Survey is a complete audit of the water entering the distribution system and is based on a system of flow measurements that has been developed and improved over many years through the contributions of engineers and superintendents. This type of service is comparable to the accounting audits made for most business organizations periodically or at the end of each year. The business firm keeps its books and manages its own affairs but finds it desirable to have accountants check the work.

The results of a few Pitometer Surveys have been published from time to time in the journals and trade papers. Some of these have been spectacular, while others have reported merely that the system was in excellent condition. In one well-maintained New England town, a recent survey resulted in a reduction in pumpage which enabled the water department to shut down the main pumping station for one day a week. In another system, the pumping hours to a high-service district were reduced almost by one-half.

The detailed methods of conducting such a survey are too well known to warrant repetition, but there are several examples of the improvement in technique that illustrate the value of flow measure-

ments. In systems where a previous survey has been made, it is sometimes economical to make a study of the consumption in the various districts of the city before carrying out detailed investigations. A comparison of the district consumption with that in previous years will indicate what sections contain an appreciable amount of new leakage. These can then be investigated in greater detail block by block, if necessary. In the early days, the amount of underground leakage and house waste was so large that there were few sections in any system where leakage did not exist. With the increase in metering and closer control by leak-minded departments, there are now many systems where the unaccounted for losses are extremely small. In these systems, many miles of main can be checked quickly by district measurements, and large sections can often be entirely eliminated as sources of leakage. This is particularly true of newer, outlying, residential districts. By careful selection of the districts, analysis of the results will quickly show where it will be worthwhile to make further investigations. These can then be made by following the same general procedure and thus quickly locating the sources of trouble.

The value of measurements in connection with this type of leak investigation cannot be overemphasized, because only in this way can all leakage be detected. There are many cases of leaks on record where it was not possible to hear a definite noise on any available connection, hydrant or valve, with any type of listening device. Certain knowledge of the size and approximate location of this type of leak is absolutely necessary before it can be uncovered. Routine listening surveys conducted by even the most conscientious operator will not result in the discovery of this obscure yet important type of leak. Very often, the larger the leak, the less noise it makes in escaping underground.

Today, water systems are much tighter than formerly, and the number that can account for 90% or more of their water is gradually increasing. In days gone by, a superintendent who could account for 75% to 80% of the water supplied to a 100% metered system felt that the conditions could not be improved upon. But today, with the increased efficiency of the Pitometer Survey, he should not be satisfied, unless he can account for 85% to 90% or even better.

Another advantage of flow measurements often overlooked is the discovery of losses other than leakage, and the collection of information

regarding the operation of the system with particular regard to pumps, meters, and tanks. These miscellaneous items vary with each system in both kind and value but are nevertheless an important by-product. In one large system, a local water hammer problem was discovered and corrected as a result of flow measurements. In another, by changing the pumping operations, substantial economies were effected. Discovery of errors in master meters have sometimes resulted in large savings to communities buying their water wholesale. There was the case, for instance, of a town buying water through two master meters through which, at times, the flow reversed and went out of the system. The town had to pay for this water twice, once when it entered the system and again when it left because certain types of meters will register positively regardless of the direction of flow. This condition was discovered during the course of routine measurements, and its correction was worth many times the leakage located.

Periodic water waste surveys are conducted in many systems throughout this country at stated intervals, depending on the rapidity with which new leakage develops. This can be determined by comparison of the results obtained by the first two surveys and varies from three to seven years. In some of our larger cities, notably Pittsburgh, Boston, Cincinnati, and Rochester, annual surveys are carried on during the months of the year when weather conditions are most favorable, thereby keeping the underground losses at a minimum. As a rule, the program contemplates covering the entire system once every five years.

Trunk Main Surveys. The value of the flow data accumulated as a by-product of the waste investigations indicated the need, some twenty years ago, for detailed information regarding the operation and condition of the expensive feeder systems in large cities. To meet this need, a system of simultaneous gaugings was developed to determine how the water flows through the trunk main system. Additional data concerning the interior condition and carrying capacity of these mains was also needed, and a technique of making loss of head tests was developed so that complete data would be available to engineering departments.

The loss of head test consists of measurement of the flow and pressure at both ends of a test section. Simple computations will then

give the flow coefficient as in the Williams and Hazen formula. The total pressure drop can be obtained in a short section of pipe simply by means of a U-tube manometer connected to each end of the section so that the total loss is indicated directly in the tube by the deflection of a liquid other than water.

This method is impracticable where the sections are over a few hundred feet long and cannot be employed on the long stretches of main that must be tested to obtain complete data on the system. The use of pressure gauges is obviously the method to use in the test of a long section but this is not as simple as it at first seems. Small errors in the gauges introduce very large errors in the results because of the relatively small total loss of head in a convenient test section. Normally these losses do not exceed about 10 ft of water or 4⅓ psi and frequently are less than 5 ft. Thus a small pressure reading error of 1 ft, or less than ½ psi, would introduce an error of 10 to 20% in the total loss. By use of special gauges and refinements in the field technique, however, it has been possible to make consistently accurate tests in sections where the total loss was as little as 3 or 4 ft of water.

The simultaneous measurement of velocity with pressure is necessary to compute the friction coefficient. A velocity measurement at each end of the test section also shows whether the side valves are tightly closed and if there is uniform flow throughout the section. This is important, because a large takeoff would make it impossible to compute the friction coefficient accurately.

The results of the Trunk Main Survey are incorporated in a special large scale map showing the relative size of the trunk mains, the direction and amount of flow at each gauging point, as well as the coefficients. The details of the tests are presented in a report that includes charts showing the hourly flow variations at each gauging point. An analysis of the data obtained is also presented, together with recommendations for correcting deficiencies revealed by the tests. These recommendations may include crossovers to distribute loads more evenly, new mains to relieve bottlenecks or overloaded sections, or cleaning to restore the carrying capacity of mains found to be badly tuberculated. This phase of the work has been particularly valuable where restoration of the original carrying capacity of a main has corrected a bad situation, simply and economically. With complete

data available in convenient form, the engineering department is thus able to make detailed studies and designs for the future.

Distribution Studies. In smaller systems, where the full-time services of an engineering department are not available, it became desirable to complete studies for a future program of construction in conjunction with field tests. In addition to the field tests previously discussed, hydrant flow tests are made using the simple Pitot tube. Pressure data are also collected wherever necessary.

With a knowledge of the system developed in the process of making the tests, and with complete data available, there is a sound basis for the design of reinforcements and future construction. The first step is to locate and correct existing deficiencies, so that the system will operate at maximum efficiency without any major improvements. Obstructions may exist in important mains beause of tuberculation, reduction of size, air pockets, or partially closed valves; connections may not function as shown on the map; tanks or reservoirs may not fill properly; low pressure areas may need reinforcement; and certain sections may not have sufficient water available for fighting fires. The best solution for these as well as other problems often cannot be determined without complete fact-finding field data.

As an illustration of this, consider a small town that obtained its gravity supply from a lake through seven miles of transmission main. When the consumption in the town reached the capacity of the main, a booster station was installed to increase the output. A continued increase in consumption due largely to periodic industrial demands created a critical situation a while ago, and it became necessary to impose serious restrictions on the town's principal industry, one with war contracts. A distribution study was authorized, and the friction coefficient of the transmission main was measured among the first of the field tests. At the same time, flow gaugings at either end of the main showed a discrepancy that amounted to 23% of the capacity of the main. This main, laid in rough wooded country, was inaccessible in many places, but a series of simultaneous gaugings resulted in isolating the loss in a short time and in the discovery of a leak discharging 230,000 gpd into a swamp. The repair of this one leak changed the immediate requirements of this community. Besides postponing the time when improvements would be needed, it greatly re-

duced the amount of new construction that would have been necessary otherwise. This is perhaps a spectacular illustration, but you can never be sure that a similar condition will not be discovered in other plants, unless flow measurements are first made.

Another use of the field data is to serve as check of the hydraulic computations. A comparison of the theoretical and actual conditions sometimes reveals situations which would otherwise not be discovered. The design of reinforcements and extensions to provide for future requirements is made after studies of the nature, amount, and location of these requirements, by means of various hydraulic computations. These have been discussed before this Association in excellent papers by G. M. Fair and T. R. Camp and need no further amplification.

After determining the necessary improvements, the final step is to prepare a master plan for future construction that is divided into convenient periods. Such a plan results in an orderly procedure of construction, designed to correct deficiencies in the order of their importance and provide for future demands approximately when they will be needed. With the aid of such a plan, post-war construction projects for example can be selected advantageously and quickly, with assurance that they will accomplish the desired results in the most efficient manner. Where paving or repaving projects are undertaken or contemplated, it is essential to have such a master plan to avoid unnecessary pavement cuts later on.

Special Tests. In addition to the three separate types of survey that I have briefly discussed, there are other important applications of the Pitometer in water distribution systems, that may come under the heading of special tests. These have been of particular importance during the last three years because of emergencies caused by the increased demand from industries, camps, or housing developments due to the war. These increased demands have had different effects. In some cases, large distribution reservoirs would not fill and storage was seriously depleted, in others pressures in some localities dropped and caused inadequate service.

A recheck where previous gaugings had been made provided a quick means of determining the exact cause of the emergency and in several instances provided the basis for a practical solution. In one complicated system, where a previous study had been made, there were

160 miles of main, five reservoirs, and seven pumping stations. The large storage reservoir was not filling, and pumping pressures had increased so that no more water could be pumped. It was thought that some radical change had taken place, but after a detailed investigation by the department it was decided to recheck some of the previous flow gaugings and friction coefficients. These were made at key points in a comparatively short time, and with the previous survey results as a basis of comparison, the cause and cure were soon apparent.

Flow data in certain isolated lines have frequently been requested during the past two years by industries and war plants in connection with the design of new units for plant expansion or to aid in the solution of operating problems. Simultaneous gaugings of the flow in river crossings is another example of special tests. These are made periodically to determine if leakage has developed. Selective leak location has been another type of special test where the Pitometer has been of invaluable aid. One large unmetered city was recently faced with the necessity of restricting operations of an important war plant. The large demand of this plant had been the last straw that broke the camel's back. Storage was being depleted at an alarming rate in spite of curtailed services, and further restrictions seemed inevitable. A complete Pitometer Water Waste Survey was authorized as the most practicable means of obtaining additional water for this plant, because it was hoped that the city would also be greatly benefited by it. The instructions were to find the maximum amount of water in the shortest possible time. The usual procedure was streamlined, and the first step was to measure the consumption by districts of over half the system. These revealed that one district had a much higher consumption per mile of main than the rest. Investigations were started in this district immediately, and further measurements were made from a series of taps located in manholes. Fortunately, an enormous amount of leakage was found to exist in a small part of this district, a large part of it on a trunk main that could be shut off entirely until such time as it could be repaired. With this main shut off, it was possible to proceed with the location and repair of other large breaks at once. This was selective leak location. As a result of attacking the worst spots first, leakage amounting to 1.7 mgd or 4.2% of the total consumption was stopped in two weeks. In four weeks, the repaired leakage amounted to 4.1

mgd or 9.7% of the total consumption, and this was enough to relax the restrictions. The reservoir started to fill, pressures increased, and a critical condition was relieved rapidly as a result of the definite knowledge obtained from flow measurements.

Conclusion. The foregoing review of the application of the Pitometer in water distribution systems is intended to reemphasize the value of flow measurements as an aid in efficient conservation and maintenance, in planning for future developments, or in solving specific operating problems.

PROCEEDINGS

November 1943 Meeting

Hotel Statler, Boston, Mass.

Thursday, November 18, 1943

President Horace L. Clark in the chair.

The President announced the death of the following members: Horace J. Cook, of Auburn, Me., and Harry C. Heermans of Hoquiam, Wash.

Secretary Gifford announced the election by the Executive Committee of the following members: Robert W. Glasheen, Superintendent, Water Department, Athol, Mass.; James J. Matera, Assistant Chief Engineer, Metropolitan Water Division, Commonwealth of Massachusetts, East Boston, Mass.; Fred E. Potter, Superintendent, Water and Sewage Department, Marion, Mass.; Clarence E. Ferry, Civil Engineer, Manchester, N. H.; and Ralph W. Horne, Sanitary Engineer, Malden, Mass.

Roger G. Oakman moved that the President appoint a committee to study the classification of water works employees and their salaries and the exhibition of the records obtained at the Association office for reference. (The motion was seconded, put to vote, and carried.)

E. Sherman Chase presented an informal progress report of the Committee on Post War Activities.

A paper, "Failure of Reservoir Dam of Belfast Water District, Belfast, Me.," was read by J. Elliott Hale, Acting Director, Division of Sanitary Engineering, State Board of Health, Augusta, Me. Arthur L. Shaw discussed the paper.

Papers on "Effect of Phosphates on Bacteria in Water," and "Bromine and Chlorine Dioxide as Possible Substitutes for Chlorine in Disinfection," were read by Joseph A. McCarthy, Chief of Laboratory, Lawrence Experiment Station, Massachusetts Department of Public Health, Lawrence, Mass.

A sound movie, "Electronics at Work," explaining briefly and

clearly the principles involved in the vital subject of electronics and their application to the service of man, was presented through the courtesy of the Westinghouse Electric & Manufacturing Company.

DECEMBER 1943 MEETING

HOTEL STATLER, BOSTON, MASS.

Thursday, December 16, 1943

President Horace L. Clark in the Chair.

Secretary Gifford announced the election by the Executive Committee of the following to membership:

Members: Lucretius H. Ross, M.D., President, Bennington Village Water System, Bennington, Vt.; John T. Broderick, Chemist with Metcalf & Eddy, Walpole, Mass.; Donald E. Stearns, Civil Engineer, Boston, Mass.

Associate: James A. Munroe & Sons, General Contractors and Engineers on Water and Sewage Treatment Plants, North Attleboro, Mass.

The President read a progress report from the Committee on Wartime Activities.

On December 2, 1943, the Joint Committee on Wartime Activities was called to Washington by Mr. Arthur E. Gorman, Director of the Water Division, OWU, of the War Production Board. The New England Water Works Association was represented by its chairman, Samuel M. Ellsworth, and Sidney S. Anthony. Ten representative water works men from different parts of the country were present. Mr. Gorman presented Mr. Ed Falck, Deputy Director of OWU, who outlined something of the background and policies with regard to water utilities. He gave certain figures to illustrate the magnitude and trend of war production. While these figures are confidential, it can be said that they far exceed the highest estimates made in 1940-41. Such production would not be possible without restrictions and curtailment in the utility field. The production peak was expected soon and there are indications that the resumption of the manufacture of certain products, restricted since the war, will be permitted in the near future.

As far as the Water Works industry is concerned, this *may* mean, for example, that larger pipe can be used where smaller sizes have been formerly prescribed; that there will be further easing of restrictions on the use of copper; that the manufacture of meters according to pre-war specifications may be resumed. There is little prospect, however, of new plant construction except as needed for war production.

Mr. Falck was doubtful about possible liberalization of the present U-1 order and there was a little discussion regarding further simplification. (At the meeting of the Maine Water Utilities Association held in Auburn, Maine, December 8, Mr. Lloyd Nelson, who recently resigned from the War Production Board, gave as his personal opinion the prediction that the U-1 order would be revised in the near future and that certain restrictions would be removed so that work permitted in one part of the order would not be restricted by following paragraphs.)

Manpower Problems. Mr. Jordan, Secretary of the American Water Works Association, had sent out questionnaires on current manpower problems to thirty-five public water works and private companies. Returns from New England included those from the City of Boston, Water Division of the Metropolitan District Commission, Springfield, Mass., Augusta, Maine, etc. The results of these questionnaires showed that in the larger cities approximately 80 per cent of the male employees are 38 years of age and that less than 10 per cent are now subject to induction. It appeared that the greatest difficulties came from private water utilities operating in many small communities. Mr. Luce of the New York Water Service Corporation presented a number of examples where their companies had been seriously crippled by the loss of key men. Most of the other water works men present indicated that they had been able to carry on necessary maintenance and operation in spite of the difficulties in holding key men, and that they would continue to be able to do so. There was some question as to whether conditions might not become so critical in the next few months that the utilities would be handicapped beyond the point of safety. Possible relief of manpower shortages may be effected by the return of disabled veterans.

Selective Service Board Bulletin 115-B. Dr. Barnard, repre-

senting the National Roster of Scientific and Technical Personnel, referred to Bulletin 115-B, issued by the Washington Selective Service Board to local draft boards under date of September 1, 1943. Briefly, this bulletin makes it mandatory for a local draft board to refer applications for deferment of men employed in critical occupations to the local office of the United States Employment Service for review. If the local office so desires it can refer the matter to the Regional Office (U.S.E.S.) for its opinion as to classification of the men in question, that is, whether he is actually employed in a critical occupation. An outline of the procedure is as follows:

1. Assume an employee holds a position coming within the definition of a critical occupation (the Bulletin contains such a list and it appears to cover most essential positions in the water works industry).

2. Assume this man is classified in 1-A by the local draft board.

3. The employer makes formal application for deferment, based on the critical occupation of the employee.

4. It becomes mandatory for the local draft board to present this request to the U. S. Employment Service.

5. The filing of the case with the U. S. Employment Service provides a temporary deferment of 30 days.

From this Bulletin it would seem that classification by the U. S. Employment Service in a critical occupation is quite certain to result in deferment of the employee, although there may be cases where local draft boards will take an independent view regardless of the ruling of the U.S.E.S.

Major Pulsifer, who represented the Selective Service Board, in commenting upon deferments, stressed the fact that a deferment is nothing but an expedient. In other words, the man is deferred only until provisions can be made by his employer for his replacement. Mr. Montgomery of the War Manpower Commission, expressed this same thought. Thus, in the case of any man under 38 years of age, single or married, deferment cannot be expected to become permanent.

There was considerable discussion regarding the procurement of men from the U. S. Employment Service. The question of wages in critical areas was discussed, particularly where war industries paid much higher wages than water utilities. No simple solution of this problem was offered.

A paper, "Post-War Plans for Extension of Water System in New Bedford," was read by Howard C. Mandell, Superintendent, New Bedford Water Works, New Bedford, Mass.

A paper, "The Application of the Pitometer in Water Distribution Systems," was read by E. Shaw Cole, Chief Engineer, The Pitometer Company, Inc., New York, N. Y. Warren J. Scott, Horace L. Clark, and Roger W. Esty took part in the discussion.

An animated sound film in color, "The Inside of Arc Welding," was presented through the courtesy of the General Electric Company.

JANUARY 1944 MEETING

HOTEL STATLER, BOSTON, MASS.

Thursday, January 20, 1944

President Horace L. Clark in the chair.

Secretary Gifford announced the election by the Executive Committee of the following new members: Abraham C. Bolde, Assistant Sanitary Engineer, Massachusetts Department of Public Health, Boston, Mass.; Joseph S. Strohmeyer, Assistant Water Commissioner, Baltimore, Md.

A paper, "Conversion for Peace in the New England Community," was read by Carl A. Gray, Chairman, Connecticut Re-employment Commission, and President, Grenby Manufacturing Company, Plainville, Conn. Francis H. Kingsbury and other members took part in the discussion.

Dr. Basil G. Bibby, Dean, Tufts Dental School, Boston, Mass., gave a talk on "Fluorine in Water and Dental Decay." President Clark, Francis H. Kingsbury, and Donald C. Calderwood took part in the discussion.

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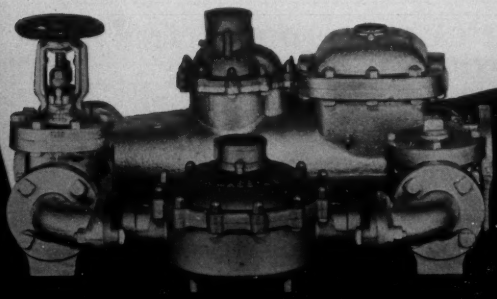

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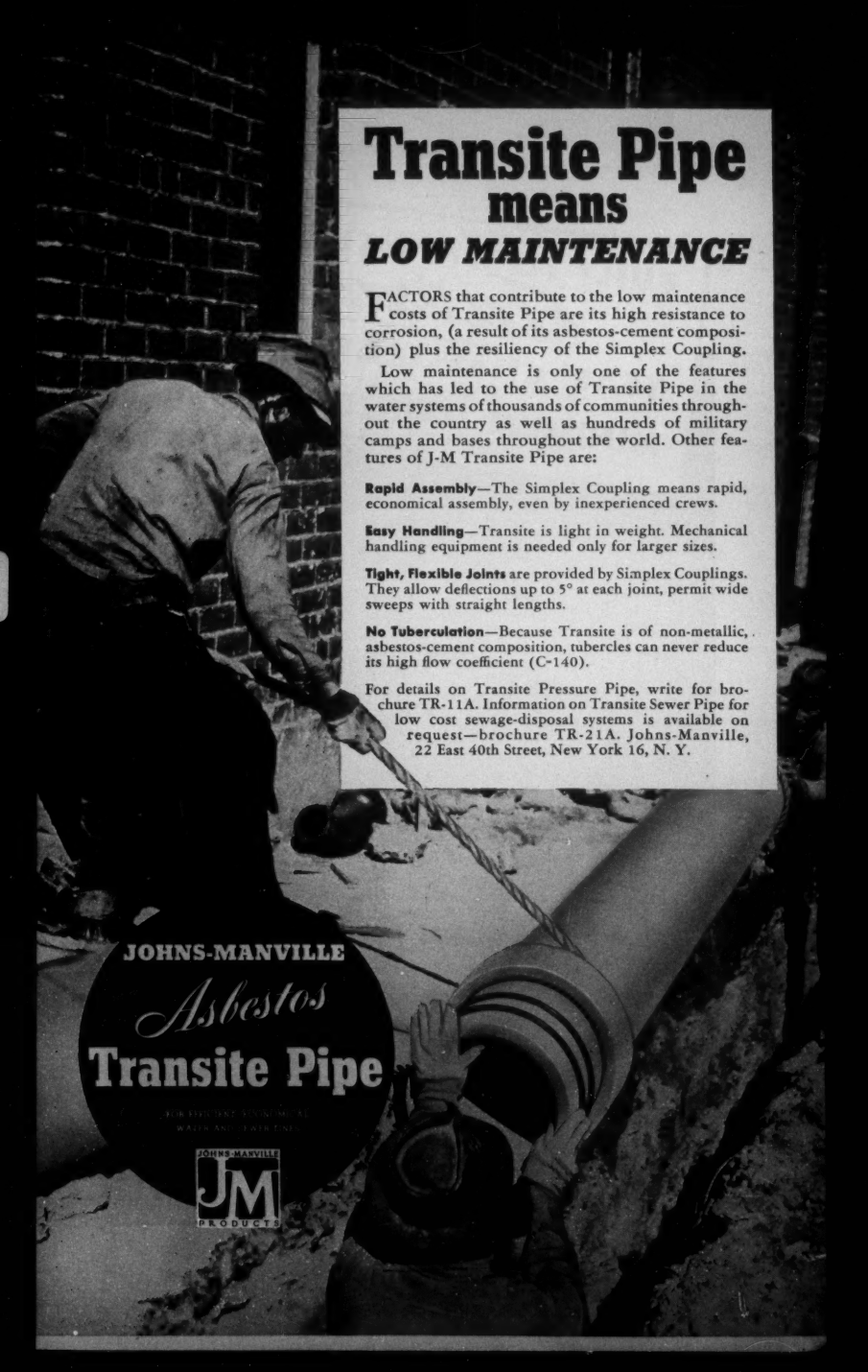

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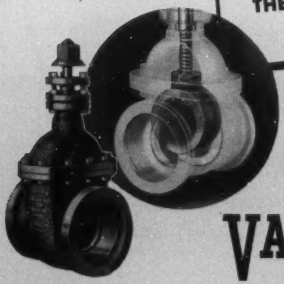

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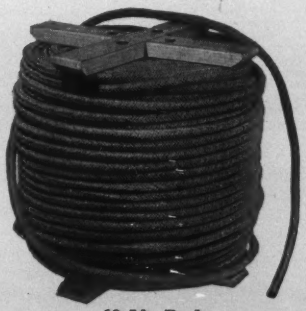

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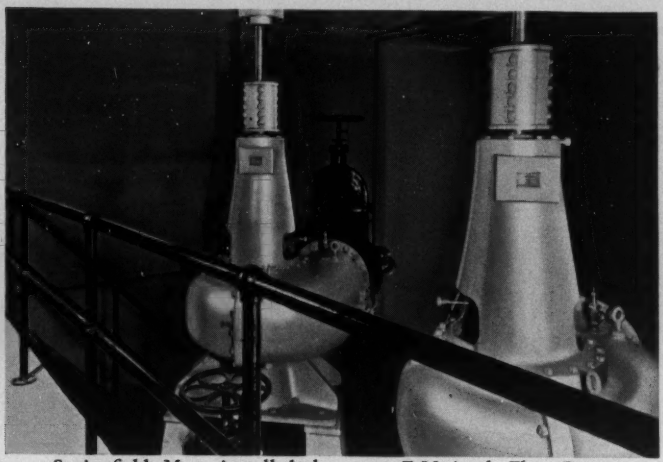

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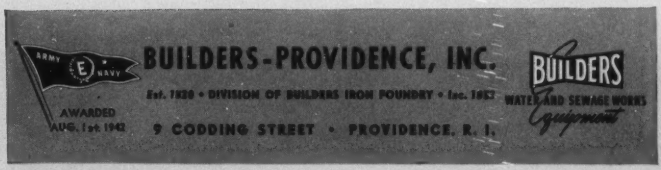

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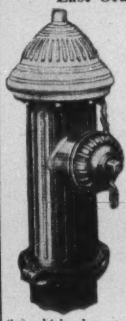

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We also make a new type of hydrant which has a breakable joint at the ground line which when struck with an impediment will break at a specified point and only a coupling has to be used to repair the hydrant, which will be back in service in twenty (20) minutes.
"HYDRANT WITH BREAKABLE COUPLING"

SMITH
WATER WORKS SPECIALTIES & SUPPLIES
THE A.P.SMITH MFG.CO. *East Orange,N.J*

IRONCRETE

IRONCRETE Meter Boxes consist of an oval iron top with a round lid having a Lifter Worm Lock, and a concrete body which you can cast yourself by means of a handy form. Durable, convenient, inexpensive,—made in two sizes. Write for catalog

FORD METER BOX CO.,
WABASH, IND.

DONALDSON IRON CO.

MANUFACTURERS
. . . OF . . .

CAST IRON PIPE

. . . AND . . .

Special Castings for Water and Gas
Also Flange Pipe and Fittings

EMMAUS, LEHIGH COUNTY, PA.

TELL US NOW

We'll Be Ready With ENOUGH
and ON TIME!

NOW is the time for a seasonal check-up of your water works requirements. Although a large part of our facilities are being used to produce specialized items for the Army, Navy, and Air Corps, we are manufacturing a full line of Water Works Products, subject of course, to WPB approval.

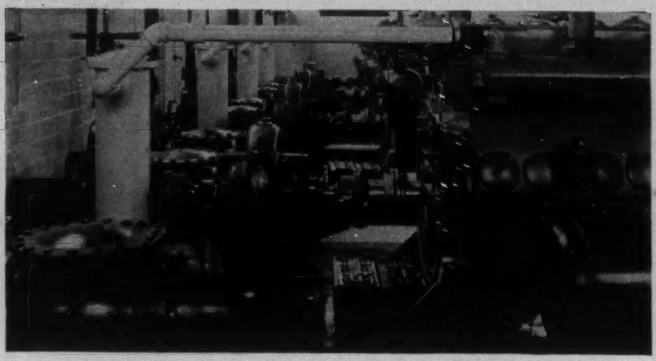
We suggest that you be conservative in your estimates, but get your orders in as quickly as possible. We will be ready with enough and on time.

SINCE 1869

WATER WORKS PRODUCTS

HAYS

INVEST IN BONDS TODAY TO PROVIDE FOR EXTENSIONS TOMORROW



Handling

1000 Gallons OF WATER

for 4/10 of a cent!

This is the rate of fuel oil cost for these four 8-in. MORRIS Centrifugal Pumps driven by Murphy Diesel Engines at the new pumping station of the City of New London, Conn.

This exceptionally efficient installation has several additional important features and advantages:

Each pump, rated for 1750 gpm against 125 ft. total head at 1140 RPM will also deliver the same capacity against 145 ft. head at 1200 RPM. This allows for the loss through a future filter plant without any change in the installation.

The installation now provides more adequate fire protection to the higher sections of the city, thus reducing the fire hazard.

The MORRIS engineers have met the required conditions without the use of gears between engines and pumps, thereby greatly simplifying the installation.

These advantages, together with the high efficiency of the MORRIS pumping units, make this plant of outstanding interest. The 80-year MORRIS experience in designing centrifugal pumps for every requirement can help give YOUR municipality a dependable, efficient plant for handling water supply, sewage, or drainage.

STARKWEATHER ENGINEERING CO.

MORRIS
ESTABLISHED 1864

NEWTON, MASSACHUSETTS

CENTRIFUGAL PUMPS

DE LAVAL

CENTRIFUGAL WATER WORKS PUMPS

Metropolitan District Comm.—Belmont Pumping Station

When we have won the war, such equipment as shown above will again be available to New England Water Works.

As Engineers and Contractors we hope to have the pleasure of supplying your requirements, at that time, as we have been doing for the past thirty-seven years.

(This is the third of a series of typical installation advertisements.)

TURBINE EQUIPMENT COMPANY OF NEW ENGLAND

80 Federal Street **Phone LIBerty 5993-5994** **Boston, Mass.**

New England Representatives for

DE LAVAL STEAM TURBINE COMPANY

TRENTON, NEW JERSEY

Meet this dual responsibility with W & T *Chlorination*

RIGHT NOW we are making every effort to keep in continuous service, as long as the war lasts, every chlorinator installation whatever its age. We are supplying necessary replacement parts and giving competent technical service — for SAFETY-FIRST.

AFTER THE WAR, new applications of Break-Point Chlorination and of Fully Automatic Control — new installations of automatic chlorinators, with chlorine flow recorders — and duplicate equipment for emergencies — will be available for the protection of your water supply — for SAFETY-PLUS.

"The Only Safe Water is a Sterilized Water"

W&T "WATCH" WORDS

Keep your eye on these keys to post-war chlorination progress:

BREAK-POINT . . . for greater health protection, plus taste and odor control.

DUPLICATE UNITS . . . for 100% safety-insurance, plus peak load reserve.

FULLY AUTOMATIC CONTROL of application, to maintain a definite residual.

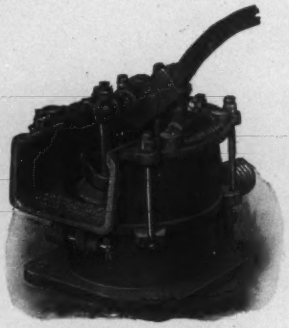
SA162-S

WALLACE & TIERNAN COMPANY, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus
Newark 1, New Jersey • Representatives in Principal Cities

EDSON

PUMPS and ACCESSORIES



Hand Pumps – Power Pumps
Truck or Trailer Mounted
Edson Special Suction Hose
Red Seal Diaphragms
Edson Bronze Hydrant Pump
Strainers, Adapters, etc.

Distributors for

Pollard Pipe Line Equipment

Electric Pipe Thawers

Universal Pipe Locator

THE EDSON CORPORATION

49 D Street, Tel. SOUth Boston 3041 South Boston
New York: 142 Ashland Place, Brooklyn

Warren Foundry & Pipe Corp.

ALSO

Warren Pipe Co. of Mass., Inc.

SALES OFFICES

11 BROADWAY, NEW YORK
75 FEDERAL STREET, BOSTON, MASS.

Manufacturers of

CAST IRON PIPE

Flanged Pipe *Flexible Joint Pipe*
Bell and Spigot Pipe
Special Castings *Short Body B. & S. Specials*
Warren (WF) Spun Centrifugally Cast Iron Pipe

WORKS: PHILLIPSBURG, N. J. and EVERETT, MASS.

Large Stock Enables Us to Make Prompt Shipments

For an Extremely Smooth Pipe Interior

SPECIFY

SPUN **BITUMASTIC** LINING

REG. U.S. PAT. OFF.

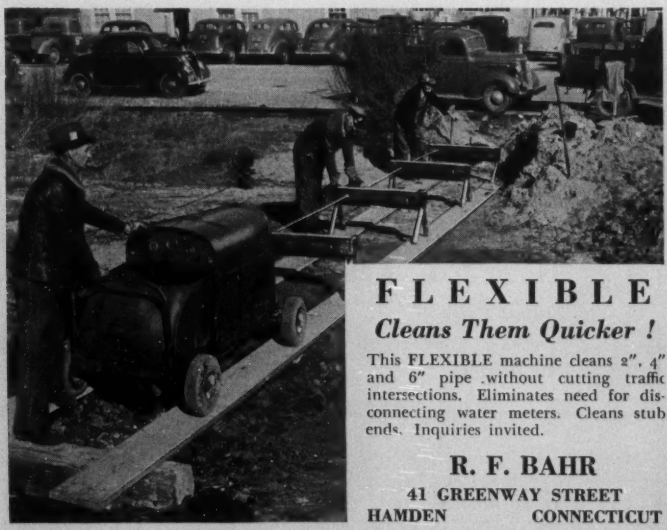
This Will Assure You of

NO LOSS IN CAPACITY
NO TUBERCULATION OR INCRUSTATION
NO EFFECT ON WATER QUALITY

Recent Repeat Flow Test Shows High Williams Hazen Coefficient Unchanged After EIGHT YEARS

Wailes Dove-Hermiston Corporation

General Offices: Westfield, N. J.
New York District Office: 17 Battery Place, N. Y. C.



FLEXIBLE

Cleans Them Quicker !

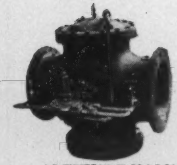
This FLEXIBLE machine cleans 2", 4" and 6" pipe without cutting traffic intersections. Eliminates need for disconnecting water meters. Cleans stub ends. Inquiries invited.

R. F. BAHR

41 GREENWAY STREET
HAMDEN CONNECTICUT

1879—ROSS— 1879

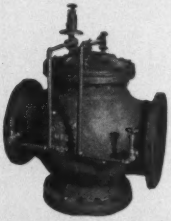
AUTOMATIC VALVES



Controls elevation of water in tanks, basins and reservoirs

ALTITUDE VALVE

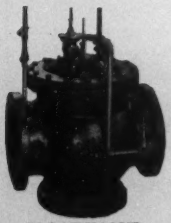
1. Single Acting
2. Double Acting



Maintains desired discharge pressure regardless of change in rate of flow

REDUCING VALVE

Regulates pressures in gravity and pump systems; between reservoirs and zones of different pressures, etc.



Maintains levels in tank, reservoir or basin

1. As direct acting

2. Pilot operated and with float traveling between two stops, for upper and lower limit of water elevation.

FLOAT VALVE

A self contained unit, with three or more automatic controls

COMBINATION VALVE

Combination automatic control both directions through the valve.

Maintains safe operating pressures for conduits, distribution and pump discharge

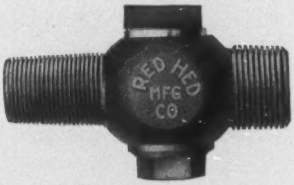
SURGE-RELIEF VALVE

Electric remote control—solenoid or motor can be furnished

REMOTE CONTROL VALVE

Adapted for use as primary or secondary control on any of the hydraulically controlled or operated valves.

ROSS VALVE MFG. CO., INC. Box 592 TROY, N. Y.



Reg. U. S. Pat. Off.

Fig. 226

Iron Pipe or Hall Thread

BETTER BRASS GOODS

GIVE BETTER SATISFACTION

RED HED BRASS GOODS

GIVE BETTER SATISFACTION,

Because

THEY ARE MADE IN OUR FACTORY AND OF BETTER MATERIALS AND WORKMANSHIP

RED HED MFG. CO.

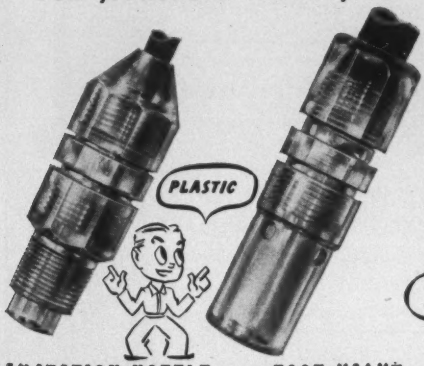
Manufacturers of

RED HED Brass Goods for Water Works

368 Congress Street Boston, Mass.

New Materials Better Accessories

FOR %PROPORTIONEERS%-CHEMICAL FEEDERS



INJECTION NOZZLE

This plastic nozzle is crystal clear and non-corrosive; flow is visible at all times. The new nozzle retains all the good features of the %Proportioneers% metal nozzle, including automatic shut off if tubing fails. Connection of compression type, for either low or high pressure hose or plastic tubing, is installed without special tools and assures a strong leakproof union.

FOOT VALVE

This improved foot valve, of non-corrosive, transparent plastic, features a cup which may be filled with glass wool or sponge rubber for filtering. Sludge-proof – with suction opening 1½ in. from the bottom of solution tank. "See-thru" construction proves at a glance that check valve is clean and working properly. Hose or tubing connection is of positive compression type.

DIAPHRAGM

This fabric-reinforced diaphragm of neoprene rubber is a superior product with longer life under more difficult operating conditions. Moulded in one piece, with non-chafing plastic push plate, no diaphragm clamp is necessary. The patented diaphragm is dish-shaped with curvature moulded into its surface to best withstand continuous flexing action.

All %Proportioneers% plastic parts are *moulded* giving higher mechanical strength and better appearance than machined plastic parts. Write *today* for full information on these and other improvements that will bring your present equipment up to date.

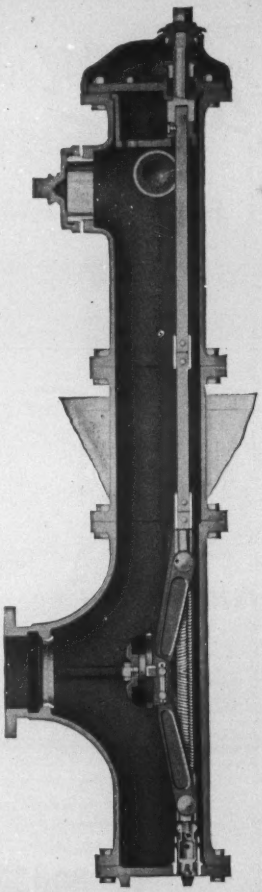
%PROPORTIONEERS, INC.%

Chemical Feeder Headquarters

WRITE TO 63 CODDING ST., PROVIDENCE, RHODE ISLAND

RENSSELAER

FIRE HYDRANTS - -



were designed with just **one** thought: to give you the **best** possible Hydrant for **Fighting Fires.** Reliability, more water, and ease of operation were the keynotes.

Yet, what other hydrant is as **easily serviced?** Only **one man** is required. **No special tools** or apparatus. **Compare!**

If you are standardized, and **thoroughly satisfied,** we naturally would **not** suggest a change. If not, our representative would be pleased to discuss your problems with you. No obligation, of course.

Nationally, RENSSELAER* hydrants are the **favorite** of Water Works executives. **That** is why we feel confident that **you** too, will wish to consider seriously the advantages they offer.

*Formerly "COREYS".

Rensselaer Valve Company

TROY, NEW YORK

New England Branch — Coombs Bldg., Haverhill, Massachusetts

Herbert H. Crowell, *Sales Mgr.*

GUNITE

USED FOR RESTORATION OF DISINTEGRATED CONCRETE

RELINING RESERVOIRS - TANKS
PENSTOCKS

PRESSURE CONCRETE COMPANY

NO. 6 AVE. B NEWARK, N. J.

Pipe Founders Sales Corporation

CAST IRON PIPE AND FITTINGS

FOR

Water, Steam, Gas and Culverts
Special Flanged and Bell and Spigot Castings
Lyncast Iron Chemical Castings

Office: 6 Beacon Street, Boston Warehouse and Yard: East Cambridge, Mass.

Half a Century of Progress

It's over a half a century—fifty-four years to be exact—since the day the HEFFERNAN PRESS made its feeble start. That each year since then has shown an increase in the volume of business over the previous year should prove that we have kept pace with the times.

The Heffernan Press

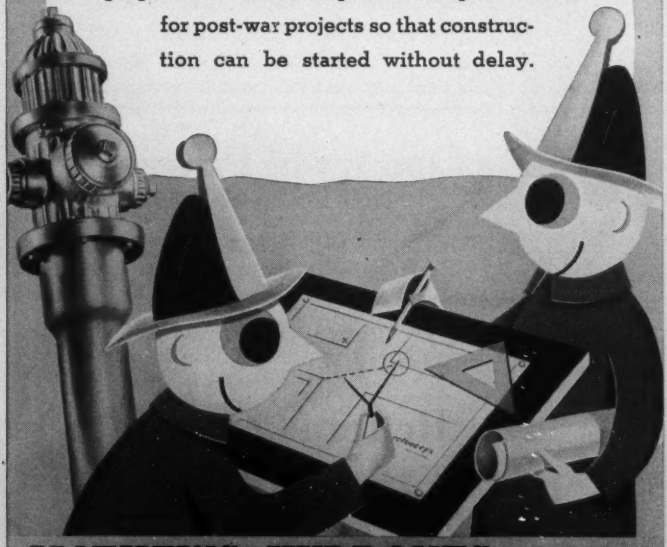
150 Fremont Street

WORCESTER, MASSACHUSETTS

Printers to
THE JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION
and *other* good publications.

"BLUEPRINT NOW"

That's the official slogan of the National Committee on Water and Sewage Works Development. Their objective is to get post-war plans out of the "talking" stage. When the war is over and the men come home, they will look to their local communities for help in earning a living. It is our very real obligation to these men to prepare *now* detailed plans and specifications for post-war projects so that construction can be started without delay.



MATHEWS HYDRANTS

400 CHESTNUT STREET, PHILADELPHIA, PA.

ESTABLISHED IN 1803

Made by R.D. WOOD Company

MANUFACTURERS OF SAND SPUN PIPE (CENTRIFUGALLY CAST IN SAND MOLDS) AND R. D. WOOD GATE VALVES

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BLUEPRINT NOW...
your postwar PLANS!

"Blueprint Now" is the official slogan of the national *Committee on Water and Sewage Work Development* organized and functioning, state by state, to get postwar plans out of the "talking" stage into blueprint form—detailed plans and specifications—so that construction can start at the drop of a hat, when armistice comes.

The Cast Iron Pipe Research Association gladly contributes additional publicity to the furtherance of this program. It is of prime importance to the community and the nation.

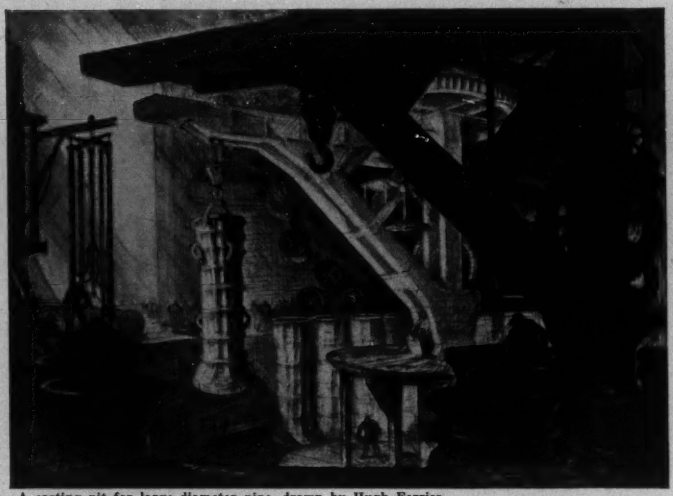
Water supply, gas and sewerage systems have been starving for needed improvements, and getting along on a bare subsistence diet for maintenance, in order to conserve manpower and materials for the war effort.

When war priorities are lifted, every community expects, and is entitled, to have these vital public services restored to full efficiency *without delay*. When returning service men are looking for work, the nation will expect that the vast reservoir of millions of man-hours of employment, represented by this deferred construction, will be ready to be tapped—*without delay*.

The way to prevent delay is to *blueprint now*. Remember that when the "dam" breaks on deferred projects—general building construction as well as underground mains—there may be a temporary shortage of certain materials until plant conversions are effected. However, cast iron pipe will be available, then as now, *without delay*.

CAST IRON PIPE

Big pipe made here



A casting pit for large diameter pipe, drawn by Hugh Ferriss.

This drawing shows a pit in one of our foundries producing large diameter cast iron pipe. We can furnish pit cast pipe in diameters 2-inch to 84-inch in accordance with all standard specifications or to meet engineers' special requirements. Pipe can be made with bell-and-spigot, mechanical, flanged or flexible joints—or with plain ends. We also manufacture Super-de Lavaud centrifugally cast pipe in diameters from 3-inch to 24-inch, with bell-and-spigot or mechanical joints or plain ends, and have stocks on hand for immediate shipment. Fittings for these types of pipe can be made promptly in our special fittings foundries.

UNITED STATES PIPE & FOUNDRY CO.

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